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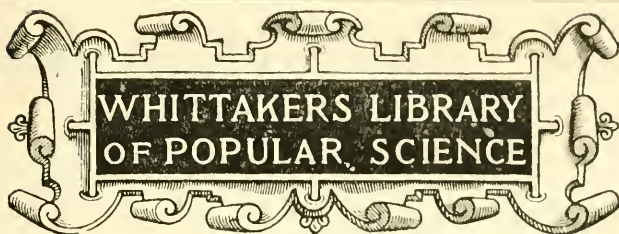
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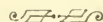
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NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

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INTRODUCTION.



IN a comparison of the position of Science to-day with that which it held fifty years ago, one is apt to be so dazzled by the brilliance of the progress as to overlook the fact that the advance has not been unaccompanied by certain tendencies which are now a stumbling block, and threaten even greater trouble in the future. Half a century ago, scientific research was almost entirely in the hands of amateurs—independent workers, as Humboldt, Darwin, Lyell, Murchison, Hugh Miller, Waterton, and others—men possessed of wide experience of affairs, who carried into scientific investigation the broad grasp of general principles, and the sound judgment gained by contact with the intricate problems of the world of work and business. Since then, there has been a great change, mainly wrought by the very rapidity of the progress. The more rigorous accuracy demanded in scientific work, the necessity of a knowledge of at least three or four modern languages, and the enormous increase in periodical literature, have combined to discourage amateurs and to encourage the growth of specialisation, with a consequent development of professionalism. This tendency was, at first, strongly resisted, and *The Natural History Review*, with other serials such as *The Intellectual Observer*, *The Popular Science Review*, and *The Quarterly Journal of Science*, strove to proclaim the latest results of scientific enquiry. The last of this group of publications, however, has been discontinued, and for some time no adequate systematic attempt has since been made in Britain to interpret simply, and without excessive technicalities, the main results of contemporary work in Natural Science to those who try to follow the general progress of modern thought.

Both naturalists and the public have suffered in consequence. The former have lost the stimulus of popular sympathy and criticism, and the contraction of the recruiting ground has diminished the number of the unattached local workers upon whose efforts progress in certain departments ultimately depends. Moreover, an ever-increasing proportion of the new recruits have entered upon their work with minds cast in the mould of one of the orthodox universities or schools, and carry it on rather as a means of livelihood than of any special enthusiasm for the cause. Hence Science has had to suffer, on the one hand, from a certain degree of lukewarmness, and, on the other, from a conservatism that has had its origin in impatience at unsympathetic and ignorant control.

The result, while it has been detrimental to Science, has been no less injurious to the cause of popular education. Tennyson, in his "Despair," represents, with powerful pathos, the condition of a man whose peace of mind had been shattered by the teachings of a science which he woefully misunderstood: it had destroyed the foundations of his old beliefs without substituting anything in their stead: it had broken the old moorings, and left the man to drift aimlessly instead of endowing him with the strength and stability with which to use the intellectual liberty he had gained. The history of our literature shows that this case has been by no means a rare one.

It is the hope of extending the knowledge of the general principles of Natural Science, of which the influence on contemporary education should be not only to stimulate, but also to moderate and strengthen, that leads to the issue of the present Review. It will be our constant aim to expound and deal in a critical manner with the principal results of current research in Geology and Biology that appear to be of more than limited application. Original articles referring to the existing status of certain special branches of Natural Science, with suggestions for further development, will be a prominent feature. Periodical summaries of the latest results in the various departments are contemplated. Reviews of the more important new books will be not merely critical, but also descriptive. Special attention will be given to the latest news concerning the work of all the principal societies and institutions throughout the world devoted to scientific and educational matters; and the correspondence columns will be open both for the discussion of the latest problems and for the purpose of replying to enquiries as to the literature of any special subject in Natural Science on which information is desired.

Such, briefly, is our ideal. We invite the co-operation of all contributors to the progress of Natural Science in striving towards its realisation.

NOTES AND COMMENTS.

THE TEACHING UNIVERSITY FOR LONDON.

THE agitation for a Teaching University for London seems at last likely to produce some practical result. Unless an address of protest be presented to Parliament before the 18th inst., the Draft Charter of the New Albert University will be granted by the Crown. This may seem a nominal success, but we greatly doubt whether most of those who have worked at this question would have troubled themselves about the matter had they seen how insignificant would be the result. Briefly stated, the ideal for which the younger London educationalists have been working is somewhat as follows. In London we have a University which is cosmopolitan in its scope ; which is a great examining board for the whole Empire, but which, in consequence, has not been able to assist much in the actual work of local teaching. On the other hand, we have in London enormous educational endowments, and a considerable number of independent institutions which for years have been doing splendid service in the cause of metropolitan education : but owing to the restrictions dictated by the special interests of the founders of these institutions, they have inherited with their endowments a legacy of loneliness that has prevented any extensive co-operation. Hence has arisen the scheme for federation of all the leading educational bodies into one great University. In this would be included not only the Royal College of Science, the City and Guilds Institute, University, King's, Bedford, and Queen's Colleges, and the great professional schools, medical, legal, and theological, but also those less formally organised institutions in which the bulk of the London middle class continues its education, such as the City of London College, the Birkbeck, the Working Men's College, and Toynbee Hall. The University Extension Society, with its more popular lecture courses, would also be represented, while the London School Board would be associated by a system of scholarships that would enable the best of its 440,000 students to train for a career of literary or scientific usefulness.

Five years ago the scheme seemed to be a beautiful, though impossible dream ; but as the Royal Commission of 1889 reported in favour of the establishment of such a University, it has been brought within the sphere of practical politics. This Commission, however, reported in favour of the reform of the existing London University, but the Senate and the Convocation have failed to agree on any definite scheme, though both are ready to move in the desired direction.

The result of the disagreement between the Convocation on the one hand, and the Senate and the Special Committee of Convocation on the other, seems to have inspired the authorities of King's and University Colleges to another effort for that joint University, the claim for which had been expressly rejected by the Royal Commission in 1889. On the present occasion, their scheme, hastily, and almost secretly discussed, has been more successful, and the draft now before Parliament is the result.

How far does this scheme answer to the ideal towards which the London educationalists have been working? Whereas the great feature of the desired University was to have been its breadth, the scheme proposed is characterised mainly by its narrowness. Out of all the institutions mentioned by the Royal Commission of 1889, only University and King's Colleges and the Medical Schools are included; and the first two of these are to have the main power, though they represent only an average aggregate of under 250 degree- or associate-seeking students. Whereas the desired University was to have been democratic and elastic, capable of constant adaptation to the ever-varying needs of London life, the proposed University is planned on the old lines, insists on large collegiate buildings for every constituent college, and requires practically whole time attendance. The scheme has, in consequence, aroused much hostile criticism, but, so far, the London scientists have held aloof, regarding the whole thing simply as a plan to enable the students at the Medical Schools to obtain easy degrees without going to Scotland. Moreover, the fact that the most noisy opposition has been based on an appeal to sectarian prejudices has not helped to rouse scientific interest in the matter. This apathy seems to us quite inexplicable. The progress of popular education is of such fundamental importance, that indifference is inexcusable. If the Draft Charter be granted, we shall have in London a University started on antiquated lines, and on a basis ridiculously inadequate to London needs: two Colleges, both with small muster rolls of students, and a few Medical Schools will be dignified by the title of the "Teaching University of London," from which, by its constitution, the vast majority of real London students will be necessarily excluded. The opportunity will have been lost for a union of all the institutions helping forward the higher education of London, that would have raised the standard of teaching, necessitated a more systematic course of study, and led to the removal of the few indifferent or unqualified teachers who at present do so much to discredit the great evening educational institutions of the metropolis. Hence, if, as we hope, the Charter now before Parliament be not granted, and the establishment of the Teaching University be again delayed, this will not have been in vain, should it result in the ultimate establishment of one based on wider lines, and more adequate to the great mission it was originally proposed to fulfil.

NEWSPAPER SCIENCE.

Some of our British daily newspapers occasionally recognise the fact that scientific news may be included among the topics of current interest. This is satisfactory. But general articles by journalists on matters relating to science are capable of doing either good or harm; and we fear the leading article on "Young Collectors," published in the *Daily News* of February 6, falls within the latter category. It is calculated to deter parents from encouraging scientific pursuits, as the following extracts will show :—

"Boys will go collecting things—it is difficult to say why. Indeed, it is not easy to explain why anybody collects anything. Probably the pleasure consists—first, in having what other collectors have not; and, secondly, in the passion for perfection and the enjoyment of the chase. . . . The things which people will collect, judging from the list of Manuals for the Young, are numerous, nor do they all excite a well-regulated cupidity. Butterflies, beetles, and moths we could do without, but London is a great place for moths, and the young collector, with the aid of sugar, may even in London pick up some moths, and a little knowledge of natural history. For fungi it is quite vain to pretend any enthusiasm. . . . Fossils are heavy, but harmless, and there are some who consider marine shells decorative objects; among these amateurs conspicuous are the keepers of lodging houses. . . . There is probably no great harm in amassing a collection of diatoms, if they do not smell disagreeably, but boys were more in the habit of collecting dormice in the years that were. We suspect diatoms, as they appear to live in ponds with algæ and the like. . . . People should be very careful how they put these things into the heads of boys."

The general tone of this article is unfortunate, to say the least, for science owes much to collectors. Many distinguished naturalists laid the foundations of their knowledge upon the collections they made in the days of their youth.

 CENTRAL ASIAN EXPLORATION.

At a meeting of the Royal Geographical Society held on February 8th, Captain F. E. Younghusband gave an interesting account of his two adventurous journeys to the Pamirs—the so-called roof of the world—lying to the northward of Gilgit, and westward of Turkestan. The first of these journeys was commenced in July, 1889, when the traveller, with an escort of five Goorkhas, left the British station of Abbotabad, in Hazara, to make his way to Leh, the capital of Ladak. From Leh the party proceeded northwards by the now well-known route across the Karakoram to Shahidula, in Turkestan, from which point their exploration may be said to have commenced. From Shahidula the route lay in a north-westerly direction, their object being first to reach the Pamirs, and thence to turn southwards and reach Hunza, in Yaghistan, to the north-east of Gilgit, by crossing the great Mustagh range. A full description of the route to the Tagh-dum-bash Pamir, by way of the Khal Khuskun Valley, and especially of the enormous and deeply crevassed glaciers,

from which the Oprang river takes its rise, was given by the lecturer. Some of these glaciers descending from the northern flanks of the Mustagh—the westerly continuation of the Karakoram—were, indeed, so cut up by crevasses that progress was found impossible, and the party met with some hair-breadth escapes from the avalanches which seem to be perpetually thundering down these valleys. The Tagh-dum-bash Pamir was eventually reached in October by an easy pass of 14,600 ft., and the transition from the deep gorges and lofty cliffs of the Yarkand river and its tributaries to the broad and open valleys of the Pamir, appears to have been very striking. Here a cold of 5° below zero was experienced. From the Pamir, Hunza territory was reached by crossing the Mintaka pass, due north of Hunza itself; the scenery down the Hunza valley to Gilgit being described as grand in the extreme, peaks of 20,000 ft. being comparatively common, while a few, like Raki-Poshi, exceed 25,000 ft. At Gilgit the party were received by Colonel Durand, the British agent. The concluding portion of the paper described a second journey round the Pamirs, commenced in the summer of 1890, when Captain Younghusband, in company with Mr. Macartney, travelled by way of Kashmir and Leh to Yarkand, thence journeying westward to the Pamirs, and reaching Gilgit in October, 1891. Although Captain Younghusband has given us much information as to the geography and ethnology of the Pamirs, we cannot help a feeling of regret that, not being either a zoologist or geologist, he is unable to give us an account of their fauna and geology.

Thus much of exploration to the north of the Karakoram and Mustagh. We learn, however, from a contemporary, that a small expedition, under Mr. W. M. Conway, has just left this country for the purpose of exploring the glaciers flowing from the Mustagh southwards into the valleys of Baltistan, or little Tibet. The great Palma (Punmah), Biafo, and Baltoro glaciers, which unite their streams in the upper affluent of the Shigar river, are believed to be the largest in the world outside the Arctic and Antarctic regions, and, although mapped by Colonel Godwin Austen, have never yet been fully explored. One of the main objects of the expedition is to attempt the ascent of Peak "K.2" of the Indian survey maps—now known as Mt. Godwin Austen—which has a height of 28,265 ft., and is believed to be the second highest mountain in the world. This magnificent peak stands on the crest of the Mustagh, and gives rise to one of the chief affluents of the Baltoro glacier, and the party are determined to see how far it is possible to ascend this giant. In their ascent of the Biafo glacier—the largest of the three—we venture to hope that the scientific members of the expedition will endeavour to give us some exact data as to the direction and extent of the band of Triassic limestone rocks which is known to lie in a trough of the gneissic rocks, and to extend towards the crest of the Mustagh in the direction of the glacier in question.

There is more news concerning the dentition of the Duck-bill (*Ornithorhynchus anatinus*), the discovery of which by Messrs. E. B. Poulton and O. Thomas excited so much interest three or four years ago. Professor Charles Stewart has met with a very young specimen in the stores of the Royal College of Surgeons, London, showing the three teeth in position in each jaw. The teeth are firmly implanted in the gum by two irregular, ridge-shaped roots, which had become absorbed in the more nearly adult specimens in the British Museum described by Mr. Thomas. Beautiful figures by Hollick accompany Professor Stewart's short paper in the first part of the new volume of the *Quart. Journ. Microscopical Science* (vol. xxxiii.).

A writer in the current number of the *Cornhill* devotes some pages of a very readable article to arguing for the high position of the Parrot tribe among birds. The power of imitation, he thinks, puts them at the very summit of the feathered race. If Mr. Grant Allen (who is, we presume, the author of this article) has ever heard the Indian Myna at the Zoological Gardens, he should have considered its claims to represent the aristocracy of birds. For clearness of enunciation the Parrot is far inferior to the Myna; and the Starling and Crow tribes generally share its capacity for imitating sounds. Professor Newton, in common with many other Ornithologists, puts these birds in the foremost place; and so far as the faculty of mimicking the human voice is a test of ornithic excellence they are justly so placed.

Surgeon-Major A. S. G. Jayakar, stationed at Muscat, at the mouth of the Persian Gulf, has for several years been making large collections of fishes. He has presented these to the British Museum, where they have been worked out by Mr. Boulenger. Through the exertions of Dr. Jayakar the fish-fauna of that part of the Indian Ocean where he has been stationed is now better known than that of many points on the coasts of India. Nearly 300 species are already on record from Muscat, among which are many described as new, or belonging to forms not before recorded from the Indian Ocean. At the last meeting of the Zoological Society a third report was read by Mr. Boulenger on the collections of fishes made by Dr. Jayakar.

Though Malta has for so long a period belonged to the British Crown, its geology is still imperfectly known. A good deal of confusion has been caused by want of exactness in the determination of the fossils; still more by mistakes as to the horizons and localities from which they were obtained. At last, however, the careful observations and the fine collection of Maltese fossils made by Mr. J. H. Cooke, are providing material for a better understanding of the Geology of the Island; and in a memoir just issued by the Royal Society of Edinburgh ("Transactions," vol. xxxvi., pt. iii.), Mr. J. W.

Gregory has availed himself of the opportunity to revise the Echinoidea, while making an analysis of the evidence they provide as to the age and origin of the Tertiary strata of Malta. The Echinoidea always form a most valuable group, when evidence is required as to the correlation of strata, or as to the conditions under which certain sediments were laid down. Mr. Gregory comes to the conclusion that the strata in question belong partly to the Oligocene, partly to the Miocene period, and that they probably range from the Tongrian (Lower Oligocene) to the Tortonian (Upper Miocene). The evidence brought forward of changes of depth, as shown by the Echinoderms, is curious. The Tertiary series in Malta begins and ends with shoal-water deposits, but the intervening strata indicate deep water. Other parts of the Mediterranean basin yield indications of a totally different succession of events. It appears as if the earth-movements on the shores of the Mediterranean have always been extremely irregular.

The origin of the "Parallel Roads" of Glen Roy is a question of perennial interest to geologists, and Mr. T. F. Jamieson returns to the subject in the February part of the *Quarterly Journal of the Geological Society*. He refers the formation of the roads (or more correctly beaches) to the action of lakes at different levels. These lakes owed their existence to the ponding-back of the water in the Glen by an ice-dam during the retreat of the last ice-sheet. The accurate maps of the Glen made by the Ordnance Survey, and the publications of the Danish Commission for the Exploration of Greenland, show that Glen Roy was once, in all probability, singularly like certain parts of Greenland, where ice-dammed lakes are still to be found in several of the Fjords.

Pleistocene botany is now attracting more attention. In *Nature* (Jan. 21) Dr. A. G. Nathorst has brought forward "fresh evidence concerning the distribution of arctic plants during the Glacial Epoch," and gives a good map of Northern Europe showing the localities from which the plants were obtained. In the *Naturwissenschaftliche Wochenschrift* (Jan. 24) Professor A. Nehring records a number of plants from the "diluvial" deposits of the province of Brandenburg; these include the Holly and Hornbeam, and are not arctic.

The *Cape Argus*, of November 18, 1891 (as we learn from the *Kew Bulletin* for January), announces that with the commencement of the present year the Cape Town Botanic Garden will cease to exist as a botanical establishment, and will be taken over by the municipal authorities to be maintained as "a town *pleasaunce* of flowers and shady walks." The director, Professor MacOwan, will be transferred to the Agricultural Department as Government Botanist. He will

also act as Keeper of the Government Herbarium, which is handed over to the same institution. According to the *Argus*, this change is necessitated by the insufficiency of the Government grant—a subsidy of £500 per annum having to meet an expenditure of about £1,400. The balance has been made up by the business of seed-selling, “and the whole energies of the staff were incessantly directed to the one object of making money enough to pay the wages and repair dilapidations.” For the last ten years Professor MacOwan has maintained the institution in this manner without incurring debt. As there is apparently no hope of improvement, the Professor has at last given up the business, assuming, probably, that his scientific knowledge and ability will be more useful as Government Botanist in the Agricultural Department. The gardens will be placed under the charge of a competent horticulturist, who will doubtless be all that municipal authorities desire. Under the circumstances detailed in the *Argus*, the change may have been inevitable, but it is none the less distressing. The value of experimental gardens and stations cannot be over-rated. We have only lately had a splendid instance in the work of Messrs. Harrison and Bovill at Barbados, resulting in the production of sugar canes from seeds, for the first time in the New World. This may be of the greatest importance to the sugar-cane industry and to our sugar-producing Colonies. Hence it is sad news to hear that a botanical garden cannot be supported in a country with a Flora so rich and characteristic as that of the Cape.

Good portraits, with brief biographies, of two British naturalists appeared last month. Mr. H. T. Stainton, F.R.S., forms the subject of the monthly biographical sketch in the February *British Naturalist*; and Mr. Robert Etheridge, F.R.S., was included in the *Mining Journal's* series of “Familiar Faces” on February 6th. We are glad to learn that, notwithstanding his retirement from the official staff of the British Museum, Mr. Etheridge continues to devote his energies to the arrangement of the Stratigraphical Collection of British Sedimentary Rocks.

The *Scottish Naturalist* has this year been transformed into a beautifully printed quarterly publication, the *Annals of Scottish Natural History*, with occasional lithographed plates. It is under the editorial direction of Professor J. W. H. Traill and Messrs. J. A. Harvie Brown and W. Eagle Clarke. A similar journal, to be published monthly in Dublin, is promised next month under the style of the *Irish Naturalist*. This will be the official organ of the Royal Zoological Society of Ireland, of the Belfast Natural History and Philosophical Society and Naturalists' Field Club, of the Dublin Naturalists' Field Club, and of the Armagh Natural History and Philosophical Society. It will be edited by Messrs. G. H. Carpenter and R. Lloyd Praeger.

I.

Some Recent Observations upon Mimicry.

SUPERFICIAL resemblances between animals, often remote from each other in the system of nature, have long been familiar to naturalists. Messrs. Kirby & Spence refer in their "Introduction to Entomology" to the case of the fly *Volucella*, which, as these authors justly remark, strikingly resembles the bee in whose nest its young are parasitic. Long before Kirby & Spence, Belon had classified whales with fishes, and similar likenesses, which imply no real affinity, even now mislead systematic zoologists every day. An excellent series of cases has been lately added to the Natural History Museum at South Kensington, illustrating a few of the more remarkable instances of particular resemblances among insects not nearly related to each other. It is to these close and often wonderfully detailed likenesses that the term "Mimicry" is usually restricted.

Before giving some account of recent facts and suggestions concerning this subject, it may perhaps be useful to remind the reader of the current theory of mimicry. Many creatures which belong to groups commonly preyed upon by larger and stronger animals, are possessed of some weapon of defence or some disagreeable attribute, which is duly advertised by a conspicuous appearance. The hornet, for example, though a giant among its own tribe, is a puny creature when compared with even a small bird. But the hornet is amply recompensed for its disadvantages in point of size and strength by possessing a formidable sting. This gives the insect a usefully evil reputation, and enables it to defy most of its natural enemies.

In this country there is a rather rare moth, which is called the "Hornet Clearwing," on account of the singular likeness which it bears to a hornet. Moths, like butterflies, have four wings densely clothed with scales; exceptionally—as with the "Clearwings" (named so for this very reason)—the wings are largely denuded of these scales; thus there is evidently at once a certain likeness to a bee or a hornet, or to any insect without scaly wings, and a corresponding difference from the scale-winged Lepidoptera. But the resemblance goes further than this; the moth has a body banded with brown and yellow, precisely like the hornet, and is of about the same size. Moreover, it has been said that this moth, when handled, moves its abdomen "in a very suggestive fashion," as if hinting at a sting

in the background; finally it appeals to another sense, for it has the characteristic odour of hornets. Presumably, therefore, this perfectly harmless insect deludes its foes into the belief that it is a veritable hornet, sting and all complete. In this particular case it is necessary to say "presumably," for, since the moth is so rare, it has naturally escaped much experiment. Mr. Poulton offered one to a lizard; the reptile looked with marked suspicion at the moth, but after licking it with its tongue, seized it by the thorax, which was at once crushed so as to kill the insect. This experiment is not, therefore, very conclusive. From the moth's point of view, it is not more satisfactory to be cautiously destroyed than to be bolted hastily. But there are other instances where an insect, owing to its similarity to some other insect, which is protected by a sting or a bitter flavour from much persecution, shares the same immunity. It is, therefore, intelligible how, as Mr. Bates first suggested, these facts of mimicry can be explained by Natural Selection. Given the utility of the resemblance, it is quite conceivable that minute variations in the required direction were perpetuated and increased.

The classical instance of mimicry is, of course, afforded by the butterflies belonging to the families Pieridæ and Heliconidæ, which were studied in South America by Mr. Bates. The Heliconidæ possess a rank flavour and odour, not only disgusting to the human nose, but to monkeys, birds, and other creatures, which, as a rule, are partial to butterflies. Two or three genera of the Pieridæ have assumed the livery of these unpopular Heliconidæ, and are believed to trade upon their reputation. It is supposed that the birds and other natural enemies of insect life have gradually, through a series of unpleasant surprises, learnt to distrust the gaudy colours of the Heliconidæ, and to assume that any butterfly coloured after the same plan would prove to be also inedible. In all these cases there is, as Mr. Poulton has admitted, "too little direct experimental proof of the unpalatability of the specially protected groups which are the chief models of mimicry." The burden of proving that the imitators as well as the imitated enjoy a considerable immunity evidently lies with the advocates of the theory. When Mr. Poulton wrote that "a peculiar and frequently unpleasant smell has been noticed by all observers who have studied" the three principal families of butterflies which are models for mimicry, viz., the Acraeidæ, Danaidæ, and Heliconidæ, he was without doubt expressing the general opinion upon the subject. Dr. Seitz, however, who has paid particular attention to this question, was unable to recognise the least odour—disagreeable or otherwise—in 50 distinct species of Danaids, both African and American. In some, but not in all the Heliconidæ, Dr. Seitz found a decidedly objectionable odour; and curiously enough in *Heliconius beski*, a species with a particularly evil odour, it was discovered that only a small percentage of individuals were odoriferous. This last fact is, of course, not contrary to the theory of mimicry, because it may be

assumed that the majority trade upon the unpleasant reputation of the few; just as the sweet-tasting Pierids are thought to lead comparatively peaceful lives by imitating the nauseous Heliconidæ.

It is, to our mind, a highly significant fact that cases of mimicry are, to a certain extent, proportionate to the number of species in the group where they occur. Among insects the vast majority of examples are met with; there are a few only reputed cases of mimicry in the two groups, Birds and Reptiles, and it is difficult to point to one example of advantageous mimicry in the Mammalia, which is the smallest group of the four. There is no *à priori* reason why mimicry should be less advantageous to a mammal than to an insect. On the contrary, indeed; for an insect as a rule leads a very short life, and when it has succeeded in laying its eggs, its claims upon life are exhausted. Natural Selection, as it has been said, cares nothing for the individual; she only concerns herself with the race. Merely from the point of view of the continuance of the race, it seems hardly necessary for a butterfly to have any assistance in prolonging its life; pairing takes place so soon. In fact, in some Lepidoptera the impatient males wait round the cocoon for the emergence of their mate. On the other hand, a mammal which has to live for a long time before being able to reproduce its kind, and is frequently preyed upon by many other creatures, both mammals and birds, seems much more entitled to the protection afforded by such a device as mimicry; so, too, with birds and reptiles.

Considering the immense multitude of insects, and the daily increase in our knowledge of hitherto unknown species (no less than 1,500 new species of Lepidoptera are recorded in the Zoological Record for 1889 as having been described during that year), and considering also the comparatively few plans of coloration that are met with, it would not be at all surprising to meet with accidental resemblances. The larger the amount of material, the larger would the number of accidental resemblances be; and this is precisely what we find.

Of more importance than purely fortuitous likenesses, supposing that such exist, are the resemblances due to similar conditions. Andrew Murray laid weight upon these little understood causes in attempting an explanation of the phenomena of mimicry. Dr. Seitz has lately discovered some curious instances, which seem to be only explicable on such a theory. In a forest of Southern Brazil, this naturalist found a perfectly circumscribed region, inhabited by insects almost entirely blue in colour; a few miles away from this spot the insects were red, yellow—any colour but blue; but in the particular area blue was so characteristic a tint that out of twenty butterflies ten were entirely blue and the remaining ten partially blue. Another equally remarkable instance of an apparent connection between colour and locality has been longer known. Ransonnet, in his work upon Ceylon, gives two beautiful plates representing life on a coral reef.

These plates were drawn by the author from a diving-bell, and illustrate the prevailing green hue of the inhabitants of the sea; animals, which in other localities are very rarely green, are green here; particularly is this so with the corals. Professor Haeckel admits this to be a remarkable fact. The prevalence of green among the inhabitants of the adjoining land is not so noteworthy a fact, since it might be reasonably put down to a protective imitation of the surrounding foliage; and green is not an uncommon colour among forest-dwelling animals.

One of our handsomest English butterflies, the "Clouded Yellow" (*Colias edusa*), has a well marked variety known as *Helice*, and this variety chiefly differs in its paler colour. In the Argentine Republic there occurs a species much like *Edusa*, which has also a varietal form differing from it about as much as *Helice* does from *Edusa*. In certain districts of the same region of America, Dr. Seitz met with a common butterfly which he at first mistook for the European *Vanessa levana*, so closely does it resemble that insect in colour and marking. Furthermore, it has a varietal form which is, in the same way, exceedingly like a variety of the European insect. A closer examination of the American butterfly showed that it belonged to a quite different genus. "If," remarks Dr. Seitz, "these insects were found in our country, no one would doubt that this is a case of mimicry as perfect as any which exists."

Sir Walter Buller, in his work upon New Zealand birds, has commented upon the extraordinary likeness which a cuckoo of the genus *Eudynamis* bears to a hawk. This fact is not new, for other cuckoos are like hawks; our own cuckoo is so much so that there is even a legend to the effect that in the winter it becomes a hawk. The interesting point about this particular cuckoo is that it "mimics," not a New Zealand, but a North American, hawk. This last instance may be fairly regarded as purely accidental; but with regard to the butterflies, we cannot but suppose that similarity in the conditions of life is responsible for their mutual resemblances. This phrase is doubtless vague and unsatisfactory, for at present we have not sufficient knowledge to formulate a more accurate statement.

It has been already pointed out that evidence is in many cases wanting of the advantages which an insect gets by mimicking another; the "Bee Hawk Moth" is an example of what might, in an oft-quoted phrase, be called "a palpably intentional likeness that is perfectly staggering"; even a naturalist of experience might be excused for putting it down as belonging to the Bee tribe. And yet Mr. Poulton found that it was eaten "without hesitation or caution" by a lizard. Dr. Seitz¹ noticed in South America a kind of "Humming-bird Hawk Moth" which closely mimicked a particular species of humming-bird found in the same locality. The resem-

¹ Stettiner Entom. Zeitschr., 1890.

blance, although striking enough to our eyes, did not deceive the insect, for it was never observed to make any attempts to pair with the bird; and it is notorious that butterflies are often deluded into believing an insect of a different species to be a suitable mate. If an insect with its limited and imperfect vision is proof against a deception which is enough to strike an observant naturalist, would birds be so?

A very singular case of apparent mimicry has not yet been quoted in popular works dealing with this subject. Dr. Bovallius² has lately described a species of Amphipod Crustacean which he named *Mimonectes* on account of its likeness to a *Medusa*. The body of this animal is produced into a dome-like structure transparent as glass, from the underside of which depend the minute legs, crowded together so as to suggest the tentacles of a *Medusa*. Here we have a resemblance which is the more striking, inasmuch as it exists between animals widely removed from each other in zoological position. And the poisonous character of the *Medusa*, armed as it is with innumerable "lasso cells," would seem to make it an excellent model for the defenceless Crustacean to copy. Furthermore, it is a pelagic animal living in the surface waters just as *Medusæ* do. Nevertheless, it is exceedingly doubtful how far the *Mimonectes* profits by its departure from the usual plan of structure of the group to which it belongs. A school of whales or a shoal of pelagic fish, rushing through the water open-mouthed and devouring all before them, could hardly be supposed to stop and analyse carefully the advantages or disadvantages of selecting or rejecting a given animal as food. And these must be the chief enemies with which small pelagic creatures have to reckon.

Another case of mimicry, which would seem to confer no particular advantage on the disguised insect, is noted by Dr. Seitz.³ He calls attention to the close similarity between two moths—*Brephos nothum* and *Ploseria diversata*—belonging to different families, which emerge from the chrysalis at about the same time. So detailed is the resemblance, that, according to Dr. Seitz, "it would be carrying scepticism too far to regard the agreement as merely the result of accident." This is plausible but not entirely convincing, if we take other facts into account. Mr. Poulton, in arguing for the efficacy of "warning colours" (and of course this will include mimicry), points out "the entire disappearance of all insects with warning colours during the seasons when insect life is scarce," and therefore in great requisition by birds. During the earlier and later months of the year, anything in the shape of an insect will be eagerly snapped up, and warning colours would become a danger signal, not to the bird, but to the insect. Now March is the month in which these two moths appear; and they are generally the only insects on the wing. They would therefore be an obvious mark for any birds that were about,

² *Nova Acta, R. Soc., Upsala*, 1885.

³ *Zoologische Jahrbücher*, 1889

which would probably be inclined, in the absence of their favourite insects, to drop the prejudices which they are supposed to entertain against brightly coloured moths.

The mimicry shown by the Sesiidæ (Clearwings) and by *Leptalis* and some other genera of the Pieridæ is less striking, inasmuch as all the members of the family or genus, as the case may be, have moved in the same direction. The very fact of the absence of scales from the wings of the Sesiidæ constitutes in itself a considerable step in the direction of resemblance to a bee or fly. It can hardly be assumed that each species of *Sesia* independently copied some Dipteron or Hymenopteron, first of all losing its scales and then becoming modified in colour and size, habits, &c. The development of this family of moths shows that the scales are partially formed during the pupal stage, but that they are arrested before they reach their full size, and then disappear. The study of the development of animals always shows, with more or less clearness, an epitome of the history of the race. Every animal, as it has been put, "is compelled to climb up its own genealogical tree." Thus these moths are evidently derived from scaled moths. A tendency to lose the scales characterises other families of Lepidoptera besides these Sesiidæ; and it is at least a reasonable supposition that this tendency may have been accentuated by the need for protection.

The principal difficulty in taking this view is the singular unanimity which the very numerous species of this group have shown in their choice of a disguise. As these insects are found in most parts of the world, and have, therefore, to cope with all kinds of hindrances to their prosperity, it might have been thought that they would display a corresponding variety in the methods by which these disadvantages are overcome. One is tempted, therefore, to believe that this family of moths were moulded into their present form by causes of which we know nothing, and that to the very considerable initial likeness to the Hymenoptera generally, such special resemblances as they show to particular bees and wasps, were added later through the action of Natural Selection.

Much more striking as evidence of the truth of Mr. Bates' theory are such cases as *Basilarchia hipparchus*. This genus of butterflyes, with the exception of the species mentioned, are dark coloured with blue spots round the margins of the wings; *B. hipparchus* is tawny-brown and black, closely simulating in tints and plan of colouration the Danaid *Anosia plexippus*. If this Danaid is really avoided by birds, we can understand why the *Basilarchia* has, so to speak, diverged from the road it ought to have followed, and imitated the *Anosia*. On the theory of mimicry, we interpret this divergence as due to Natural Selection gradually acting on a small initial difference; and if an insect is found whose colouration is strikingly unlike that of its immediate allies, it is apt to be assumed that another insect will be found which it imitates. But this assumption

is by no means always correct; and the existence of such forms is a difficulty in the way of accepting the theory of mimicry. If a butterfly has abandoned the usual dress of its genus without any object in doing so, it might fairly be asked whether, when a resemblance to another form does occur, it is not accidental. If a divergence from the normal style of colour and marking does not always go with the existence of a prototype belonging to a different genus or family, a certain amount of doubt is naturally thrown upon the validity of the explanation in other cases where there is a prototype. Mr. Scudder has suggested this difficulty, and has grappled with it in his magnificent work upon the butterflies of North America, recently published.⁴ He quotes two suggestions that have been made by way of explaining the matter. The first is the obvious one that the model which is imitated *does* exist, but has not been found; the second suggestion is that the prototype *did* exist, *i.e.*, that it has become extinct. The mimicking form may then be supposed to have secured and established its position by the help of its vanished model, just as a dishonourable firm may trade for a time under an old-established name no longer represented in the firm. Both these suggestions are easier to make than either to prove or refute. The third explanation is the most satisfactory. Mr. Scudder believes that in cases of this kind we have to do with a general mimicry in course of conversion into a special mimicry—that is to say, the mimicking insect has got so far as to bear a certain likeness to the members of another group, but has not yet acquired a particular likeness to any one species. The general resemblance might in the meantime profit the insect. The Marbled White butterfly may be mentioned as a possible example; it has departed from the usual brown colour of its immediate relatives, and has become something like the “Whites,” but is not yet like any one species. A comparatively small change would convert it into a good likeness of any species of “White.”

FRANK E. BEDDARD.

II.

Deep-Sea Deposits: A Review of the Work of the "Challenger" Expedition.¹

THE long-expected report by Messrs. Murray and Renard on the deep-sea deposits collected during the cruise of the "Challenger," has made its appearance, and will be cordially welcomed by all geologists. Many of the facts and most of the conclusions have been published in the proceedings of various societies, and have even found their way into text-books. Nevertheless, it is to this volume that all those who are desirous of studying the geological operations at present going on in our great ocean basins will necessarily turn.

The work forms a bulky quarto volume of five hundred pages. It is illustrated by forty-three charts indicating the positions of the sounding and dredging stations, a coloured map of the world representing the distribution of the principal deposits, twenty-two diagrams showing the vertical distribution of temperature and the relations between the deposits and depth, thirty-six woodcuts, and twenty-nine lithographic and chromolithographic plates, many of which are beautifully executed and give an excellent idea of the objects they represent.

The deposits were examined in the following way. The proportion of carbonate of lime was approximately ascertained in each case by the direct determination of carbonic acid. The relative amount of the remains of the different lime-secreting organisms was roughly estimated by microscopic examination. The residue in the carbonic acid apparatus was then separated into three parts—siliceous organisms, minerals, and fine washings—by fractional decantation, and the relative proportions of these three constituents also estimated. The percentage composition of each deposit is given in terms of (1) pelagic foraminifera, (2) bottom-living foraminifera, (3) other calcareous organisms, (4) siliceous organisms, (5) minerals, and (6) fine washings. Under the last head are included argillaceous material, organic matter, minute fragments of siliceous organisms,

¹ REPORT ON DEEP-SEA DEPOSITS BASED ON THE SPECIMENS COLLECTED DURING THE VOYAGE OF H.M.S. "CHALLENGER." By JOHN MURRAY, LL.D., Ph.D., and REV. A. F. RENARD, LL.D., Ph.D. London. Eyre and Spottiswoode, 1891.

and mineral particles too small for precise determination. These fine washings do not make up a pure clay, but a substance allied to bole-clay rich in iron and manganese.

The 100-fathom contour is taken as the more or less arbitrary boundary separating the deep-sea from the shallow water deposits. This contour line divides the continental masses from the great oceanic depressions. The area of the ocean between the shore and the 100-fathom line is about ten millions of square miles, whereas that between the 100-fathom and 500-fathom lines is only seven millions. The area between the two last-mentioned contours may, therefore, be spoken of as the continental slope.

Marine deposits in general are classified as follows :—

Deep-sea deposits beyond 100 fathoms.	{	Red clay.	}	Pelagic deposits formed in deep water far away from land.
		Radiolarian ooze.		
		Diatom ooze.		
		Globigerina ooze.		
		Blue mud.		
Shallow-water deposits between low-water mark and 100 fathoms.	{	Red mud.	}	Terrigenous deposits formed in deep and shallow water close to land masses.
		Green mud.		
		Volcanic mud.		
		Coral mud.		
		Sands, gravels, muds, &c.		
Littoral deposits between high- and low-water marks.	{	Sands, gravels, muds, &c.	}	

The following table indicates the average depth at which each of the more important deposits is found, the average amount of carbonate of lime present, and the area of distribution :—

	Mean depth in fathoms.	Mean percentage of Ca CO ₃ .	Area, sq. miles.
Red clay	2,730	6.70	51,500,000
Radiolarian ooze	2,894	4.01	2,290,400
Diatom ooze	1,477	22.96	10,880,000
Globigerina ooze	1,996	64.53	49,520,000
Pteropod ooze	1,044	79.26	400,000
Coral mud	740	86.41	2,556,800
Coral sand	176		
Other terrigenous deposits ..	1,016	19.20	16,050,000

It is with the deep-sea deposits alone that the authors of the present volume are concerned. These cover more than one-half of the earth's surface, and pass gradually into the shallow-water deposits. Phenomena of erosion are almost entirely absent from the deep sea, and the only mechanical actions of any consequence are those connected with submarine volcanic eruptions. The effects of chemical action, on the other hand, are strongly marked by the occurrence of glauconite, phosphatic nodules, manganese nodules, and zeolites.

The pelagic deposits are essentially made up of the remains of pelagic organisms—pteropods, heteropods, foraminifera, diatoms, and radiolaria—together with the products of volcanic eruptions and secondary products resulting from the decomposition of the latter. Uniformity over large areas is a special characteristic of these deposits. The authors do not admit that any formations identical with the typical pelagic deposits are to be found in the rocks of which the land is composed. They refer, however, in a footnote, to the oceanic deposits of Barbados, recently described by Messrs. Harrison and Jukes-Browne, and to the radiolarian cherts of the south of Scotland described by Dr. Hinde.

The first three chapters deal with the collection and examination of deep-sea deposits, the composition of the samples obtained at 354 stations (this being given in a tabular form) and the general nature and distribution of the different kinds of deposit. The last three chapters treat of the constituents of the deposits, and we will refer to these first. They are classified as follows:—(1) Materials of organic origin; (2) mineral substances of terrestrial and extra-terrestrial origin; and (3) chemical products formed *in situ* on the floor of the ocean.

Nearly all the deep-sea deposits contain traces of albuminoid and other organic matters. These substances give rise to sulphuretted hydrogen by decomposition, and thus lead to the formation of sulphides, especially sulphide of iron, in the blue muds. The food of the deep-sea animals is the organic matter which falls from the surface and intermediate waters. The stomachs of echinoderms, annelids, and other organisms living on the bed of the sea, were always found to be full of the surface layers of the ooze. Thus a large proportion of marine deposits must have passed through the intestines of marine animals. That the same kind of action took place in past time is shown by the extraordinary abundance of worm-casts in some geological formations, as, for example, in the Cambrian rocks of the North-west of Scotland.

The different classes of organisms whose remains occur in the deposits are considered in detail, and the relative frequency of these remains in the different kinds of deposit is described. The division of the oceanic organisms into those which live in the waters and those which dwell on the floor of the ocean—the Plankton and Benthos of Haeckel—is of primary importance from the point of view of the origin of deep-sea deposits. The “Challenger” observations show that 90 per cent. of the carbonate of lime in these deposits is due to the remains of pelagic organisms. The nature of the deposit varies with the latitude, and depends upon the character of the surface fauna and flora. The calcareous organic remains belong principally to pelagic foraminifera, mollusca (pteropods and heteropods), and algæ (coccoliths and rhabdoliths).

The general absence of the exoskeletons of the higher crustacea

and the bones, other than otoliths, of fishes is remarkable, and indicates that hard parts containing a large amount of phosphate of lime and organic matter are especially liable to decomposition and solution. The siliceous organisms which contribute to the formation of widely distributed deposits are radiolaria and diatoms. Sponge spicules are very commonly present, but do not form an important part of any of the deposits examined. Hexactinellid spicules are characteristic of the deeper waters; tetractinellid and monaxonid spicules, on the other hand, occur most abundantly in the shallower regions. Vertebrata are represented principally by the teeth and otoliths of fishes, and the ear-bones of whales; some of these remains, including the *Carcharodon megalodon* of the Crag, are believed to be referable to extinct Tertiary species. More than fifteen hundred sharks' teeth were obtained in one haul at a point in the South Pacific.

The mineral constituents not formed on the floor of the ocean separate themselves into two well-marked groups: (1) pyroclastic materials, including crystals, crystal fragments, pumice, lapilli, and minute glassy particles; (2) detrital materials, resulting from the destruction of crystalline, schisto-crystalline, and epiclastic rocks. The former are universally distributed; the latter are practically limited to a comparatively narrow zone round the land masses, and only occur in the pelagic deposits where these are formed under the influence of ice-drift, or in regions where the surface is exposed to powerful winds blowing from desert regions.

The universal distribution of pyroclastic materials, including pumice, is not surprising when we take into consideration the positions of active volcanoes in relation to the sea and the characteristic phenomena of paroxysmal eruptions. Submarine volcanic action must also contribute to the supply of pyroclastic material. Fragments of pumice varying in size from that of a man's head to that of a mustard seed, and generally more or less rounded, were dredged at many stations, sometimes hundreds of miles from land. The surface layers, in all cases, had been more or less changed to a soft clayey material—a fact of some importance as bearing on the origin of abyssal clays. The three main types of volcanic rocks—acid, intermediate, and basic—are all represented amongst the "Challenger" collections. By the disintegration of these different varieties of pumice, minute glassy particles are formed and minerals liberated, both of which are identical with the constituents of fine volcanic ash. It is not always possible, therefore, to say whether a given crystal or glassy fragment has been produced by the destruction of pumice or by the actions which accompany paroxysmal eruptions.

In many regions of the deep-sea, lapilli and pebble-like fragments of a basic volcanic glass were obtained. These were always found to be more or less altered to a resinous, yellowish green, or reddish brown substance, having all the characters of palagonite. The minerals

embedded in the glass are those of basic igneous rocks—olivine, augite, and plagioclase. The fragments of basic glass are very commonly associated with manganese nodules, and often form the nuclei round which deposition has taken place. In some localities actual deposits of palagonitic tufa, with the different lapilli in their original relative positions, have been brought to the surface enclosed in the larger and somewhat tabular concretions. The change from basic glass to palagonite is shown by analysis to be accompanied by hydration, removal of lime and magnesia, oxidation of the ferrous iron, and addition of alkalis.

Non-volcanic minerals and rocks are, as a rule, absent from the pelagic deposits. The most characteristic minerals are glaucophane, white mica, sericite, tourmaline, zircon, and microcline. Most of the quartz is also of non-volcanic origin. It is in the terrigenous deposits of the continental slope that the above minerals are found.

When the particles which can be extracted from a deep-sea deposit by a magnet are examined under the microscope, a few black and brown spherules may not unfrequently be observed amongst them. These are supposed to be of extra-terrestrial origin. The black spherules rarely exceed .2 mm. in diameter. They have an external crust of magnetic oxide of iron, and usually an internal metallic nucleus. They would be perfectly spherical in form if it were not for a slight depression or cupule which is almost invariably present. The metallic nucleus either consists of iron or of iron alloyed with cobalt and nickel. The brown spherules have a mean diameter of .5 mm. and a peculiar radial, excentric, lamellar structure known only in the chondres of meteorites. At first they were believed to be formed of bronzite, the mineral of which the chondres are composed, but more detailed examination has led the authors to the conclusion that the mineral in this case is a monoclinic pyroxene. Blackish-brown inclusions, similar to those occurring in hypersthene, are present in these peculiar bodies, and it is to these inclusions that their magnetic properties are due.

The black and brown spherules were found in the greatest abundance in the red clays of the Central and Southern Pacific. Twenty or thirty black, and five or six brown spherules may usually be obtained from a quart of the clay. Manganese nodules, sharks' teeth, and the ear bones of whales abound in the same localities. In the pelagic deposits of the Central Pacific, other than red clay, magnetic spherules are far less abundant, but a careful search through a large quantity will usually result in the discovery of one or two. These facts clearly point to the conclusion that the spherules are most abundant where the rate of accumulation is slowest.

The chemical deposits forming *in situ* on the floor of the ocean are considered under the following heads:—(1) Clay, (2) Manganese nodules, (3) Glauconite, (4) Phosphate nodules, (5) Zeolites. The argillaceous matter of the red clay and other pelagic deposits is

believed by the authors to be due mainly to the decomposition of volcanic products. They do not deny, however, that a small quantity may be derived from the land.

Concretions rich in hydrated oxide of manganese were found in the Atlantic, Indian, and Pacific Oceans. They were frequently brought up by the trawl from great depths in extraordinary numbers. Thus, from one haul in the South Pacific between two and three bushels were obtained, together with 50 bones of whales, 1,500 sharks' teeth, 6 ice-borne pebbles, and 12 rounded pieces of pumice. The concretions vary in size from microscopic particles to large masses, of unknown dimensions, from which fragments have been torn off by the action of the dredge. The common form is that of more or less rounded or nodular masses, varying from 1 to 15 cm. in diameter. The larger nodules frequently contain several nuclei. The depositions commenced round several foreign bodies lying near each other on the bed of the sea, and increased so as finally to enclose them all in one compound nodule. The nuclei are of the most varied character. They consist of fragments of pumice, lapilli, sharks' teeth, ear-bones, sponges, and even portions of the local deposit. A concentric arrangement is seen in section. This is brought out by a variation in colour in the successive zones, the lighter zones containing a larger admixture of clayey or earthy material. The manganese hydrate is opaque in the thin sections, and without crystalline form. The characteristic dendritic structure may, however, be seen in the lighter-coloured layers of the nodules.

Dittmar's experiments indicate that the oxygen present is more than sufficient to form a binoxide of manganese. Renard concludes from his analysis that the condition of the manganese as regards oxidation and hydration, is expressed by the formula $\text{MnO}_2 + \frac{1}{2} \text{H}_2\text{O}$, and that this compound is associated with 26.7 per cent. of limonite. It must not be supposed that the nodules are pure manganese compounds. They always contain hydrated ferric oxide, as well as clay and other constituents. Dr. Gibson subjected a very large quantity of the material of the nodules to an exhaustive examination for the purpose of determining the presence or absence of the rarer elements. In addition to the ordinary constituents, he found tellurium, lead, copper, molybdenum, thallium, vanadium, zinc, nickel, and cobalt. Nickel is present in sufficient abundance to be estimated, even in small quantities of material.

Mr. Murray believes that the manganese has been chiefly derived from the decomposition of the basic volcanic material with which the nodules are so frequently associated. The amount of manganese present in this material is, however, so small, that if the nodules obtained their supply from this source they would probably be embedded in such a mass of clay as not to be obtainable in great numbers by the dredge. We accordingly agree with the opinion expressed by M. Renard, in a footnote, that the bulk of the

manganese has been obtained in some way from the sea water. May not the presence of manganese in the deep-sea deposits be due to the action described by Dieulafoy—precipitation from a solution of the carbonate, in consequence of oxidation—and its local accumulation as nodules to some of the little known chemical processes going on upon the sea-bed? The wide distribution of manganese, in a finely divided state, in the red clay areas of the Pacific, is shown by their chocolate-brown colour, and also by microscopic examination of the deposits themselves.

Another chemical product of great geological interest in course of formation in existing seas is glauconite. It forms an appreciable part of the green sands and muds, and is found as isolated grains in most of the blue muds. The grains rarely, if ever, exceed 1 mm. in diameter. The typical grains are always rounded, often mammillated, and of a black or dark green colour. Their forms often suggest in a vague manner those of foraminifera. Mixed with the typical grains are others, of a pale green colour, which are clearly the casts of those organisms. Foraminifera wholly or partially filled with glauconite, or allied substances, were very commonly observed, and the appearances often suggested the conclusion that the growth of the glauconite in the interior had broken off portions of the shells. We may therefore suppose that the typical grains, of vague form, are produced by growth after the shell has disappeared. The chemical and microscopic characters of the recent glauconite are identical with those of the same substance occurring in our green-sands, as may be seen by comparing the description and analysis given in the Survey Memoir on the Geology of the Isle of Wight with those of this Report. The minerals associated with glauconite are those of the terrigenous deposits. All the facts point to the conclusion that glauconite is formed in the first instance in the hollow spaces of calcareous organic remains, and especially in the interior of the shells of the foraminifera.

A few phosphatic nodules were dredged by the "Challenger," and those from the outer edge of the Agulhas bank and from a station in deep water to the south of the Cape of Good Hope are described in detail. They vary in diameter from 1 to 3 cm., as a rule, but may occasionally measure as much as 6 cm. across. The phosphate of lime is amorphous, and merely acts as a cement to the other constituents which are accumulating at the spot where the nodule was obtained. Thus, in the concretions from the station on the Agulhas bank, the phosphate of lime encloses grains of glauconite and quartz; while in those from the deep-water station, the shells of foraminifera filled with and more or less pseudomorphosed by phosphate of lime are to be found.

The only chemical deposits which remain to be described are crystals of phillipsite. These were especially noted in the red clay areas of the central Pacific, where they occasionally make up 20 or

30 per cent. of the deposit. They have been found also in the Central Indian Ocean, and in other deposits besides the red clay. They occur as extremely minute prisms, crossed twins, and as globular or spherulitic aggregates. There appears to be a connection between the distribution of phillipsite and that of the fragments of basic volcanic glass and basaltic lapilli. This leads the authors to conclude that the materials of the former have been derived from the latter; so that there is in this case no violation of the law connecting the formation of zeolites with the decomposition of igneous rocks in their immediate neighbourhood.

We have now to refer briefly to that portion of the report which deals with the nature and distribution of the different deposits. Red clay is found in the greatest depths and at the greatest distance from land. It is the most widely distributed of all the deep-sea deposits, and was found at seventy stations which range in depth from 2,225 to 3,950 fathoms. The colour and amount of hydrated silicate of alumina are both liable to considerable variation. In the North Atlantic the colour is a brick-red, owing to the presence of a thin pellicle of ferric oxide on the surfaces of the minute mineral particles. In the South Pacific and Indian Oceans, the deposit often assumes a chocolate-brown colour, in consequence of the presence of minute rounded grains of peroxide of manganese. Unlike a pure clay, this deposit will fuse in the blow-pipe flame to a black, often magnetic bead. As a rule, the red clay is smooth and soapy to the touch, but occasionally a gritty feeling, due to the presence of pellets of peroxide of manganese, zeolitic crystals, or fragments of pumice, may be noticed. The extraordinary abundance of manganese nodules, sharks' teeth and cetacean ear-bones has already been mentioned. Hydrated silicate of alumina never forms more than one-half of the deposit. Carbonate of lime ranges from 1 or 2 per cent. in the deeper parts to 20 per cent. near the upper limit. It is due to the presence of the remains of calcareous organisms which resemble those living at the surface in the same neighbourhood. Large and small fragments of pumice were dredged and trawled in great numbers and in almost all regions. The mineral constituents are those of volcanic rocks—sanidine, plagioclase, augite, hornblende and magnetite. Ice-borne fragments of rock and terrigenous minerals are found in the Southern Ocean.

Radiolarian ooze, like the red clay, is found only in the greatest depths. The constituents are the same as those of the preceding deposits, but the relative proportions are different. The remains of radiolaria and siliceous organisms make up at least 20 per cent.—in one case 80 per cent.—of the deposit. The nine specimens obtained by the "Challenger" range in depth from 2,350 to 4,475 fathoms. Radiolarian ooze is known only in the Pacific and Indian Oceans. It has not been found in the Atlantic.

Diatom ooze is mainly composed of the frustules of diatoms, but

the remains of radiolaria and sponges may also be present. When wet, it has a yellowish straw or cream colour; when dry it resembles flour. This deposit was found by the "Challenger" in the Southern Ocean only, and within the limits of the Antarctic ice-drift. The mineralogical and petrological constituents are accordingly much more varied than is the case with the previously described deposits. Fragments of granite, micaceous sandstone, amphibolite, gneiss, schists, and slate have been found, together with such minerals as might be derived from these rocks. The ubiquitous volcanic rocks and minerals are also present. Diatom ooze has been found by the "Tuscarora" in the northern part of the Pacific Ocean.

The term globigerina ooze has been applied by the authors to those deposits which contain over 30 per cent. of carbonate of lime, principally due to the shells of pelagic foraminifera belonging to the genera *Globigerina*, *Orbulina*, and *Pulvinulina*. Bottom-living foraminifera, such as those belonging to the Textulariidae, Miliolidae, and Nummulinidae, may also be present, but not to any great extent. Shells of the pelagic mollusca are frequently found. In regions far removed from land, particles of volcanic glass and the minerals felspar, augite, and hornblende are found, without any admixture of land detritus; but where the globigerina ooze approaches land and merges into the terrigenous deposits, a considerable amount of such detritus is present. 118 samples are classed as globigerina ooze; they come from depths ranging from 400 to 2,925 fathoms. Pteropod ooze differs from globigerina ooze only in the greater abundance of pteropod and heteropod shells. It is found in shallower water than the typical globigerina ooze, and is known only in the Atlantic. In the following table, column I. represents the average composition of red clay; column II. that of radiolarian ooze, and column III. that of globigerina ooze:—

		I.	II.	III.
Carbonate of lime	{ Pelagic foraminifera ..	4'77	3'11	53'10
	{ Bottom-living foraminifera ..	0'59	0'11	2'13
	{ Other organisms	1'34	0'79	9'24
		6'70	4'01	64'47
Residue	{ Siliceous organisms ..	2'39	54'44	1'64
	{ Minerals	5'56	1'67	3'33
	{ Fine washings	85'35	39'88	30'56
		93'30	95'99	35'53
		100'00	100'00	100'00

The percentage composition of each of the deposits is given in the same way; so that an enormous amount of labour must have been expended in the preparation of this Report.

We come now to the terrigenous deposits. Of these, blue mud is the most widely distributed. The upper layer is red or brown, owing to the presence of ferric oxide or ferric hydrate. Only the lower portions show the characteristic colour. In these, a reduction

of the iron oxide has taken place in consequence of the presence of organic matter, and sulphide of iron is present in a finely divided state. When fresh, these deposits usually have the smell of sulphuretted hydrogen. The proportion of carbonate of lime may vary from a mere trace to 35 per cent. The mineral particles range in size from .06 to .3 mm. in diameter, the average being .115 mm. Quartz particles which are rare or absent in the pelagic deposits are the most abundant of the definitely recognisable constituents; orthoclase, plagioclase, green hornblende, augite, white and black micas, epidote, chlorite, zircon, and tourmaline have also been determined. Glauconite is not characteristic, but may be found in almost all the specimens collected during the cruise. The blue muds differ from the red clays in containing a much larger proportion of minerals (22.48 per cent. on the average), and a smaller proportion of fine washings (61.77 per cent.). They surround nearly all coasts, and are found also in inland seas, such as the Mediterranean. Off the coast of Brazil, a red mud is found in place of the more widely-distributed blue mud. This is said to owe its colour to the ochreous matter carried out to sea by the great South American rivers. It contains, however, less iron than the blue mud, so that the peculiar colour must be due to the absence of the reducing conditions which prevail over the areas covered by blue mud. Similar deposits occur off the Chinese coast near the mouth of the Yang-tse-kiang.

The green muds and sands owe their distinctive features to the presence of glauconite. They grade off on the one side into blue muds and on the other into globigerina ooze. Volcanic muds and sands are found in the immediate neighbourhood of volcanic islands. The volcanic material is mixed with a variable amount of calcareous and siliceous matter, chiefly due to the remains of the usual pelagic organisms. Coral muds and sands surround coral islands in the same way.

More than one hundred and fifty analyses of the deposits and of special substances obtained from them are given in an appendix to the Report.

It will be seen from the brief account we have given of this most valuable Report that the detailed study of specimens in the laboratory has confirmed and extended the conclusions arrived at during the cruise. The deep-sea deposits are essentially made up of the remains of pelagic organisms and volcanic products. Terrigenous material is almost entirely absent. The proportion of carbonate of lime decreases as the depth increases below 2,000 fathoms; this is owing to the solvent action of sea-water on the calcareous organic remains. The deposits of the greatest depths are, therefore, almost entirely derived from siliceous organisms and volcanic material.

The broad features of the distribution of the more important deposits may now be briefly summarised. Proceeding outwards

from the shore, we first meet with the variable deposits of the littoral and shallow-water zones. Banks of sand heaped up under the influence of tidal currents, and wide stretches of mud in the deeper and quieter regions. Here and there occur local accumulations of shells and shelly *débris*. Near the 100-fathom line blue muds are found, and as these are followed down the continental slope, they merge, near its base, into Globigerina ooze—a deposit which extends with wearisome monotony over immense areas. As we descend into the abysses of the ocean, to depths exceeding 2,500 fathoms, the globigerina ooze passes into “grey” ooze, and this again into red clay—the most widely distributed of all the deep-sea deposits.

The physical conditions at great depths are practically the same from the equator to high latitudes. Seasonal changes are absent, and the temperature is uniform. Notwithstanding this, there is a marked variation in the character of the organic remains found in the deposits. Foraminifera are larger and more varied in form in the tropical regions. Coccoliths, rhabdoliths, and the remains of the pelagic mollusca are entirely absent from the deposits of high northern and southern latitudes. These variations with latitude are due to the fact that the organisms which make up so large a portion of the deposits live at the surface, where their distribution is determined by the distribution of temperature.

J. J. H. TEALL.

III.

The Evolution of Fins.

OF the multitudinous theories relating to the origin and development of fin-structures in fishes, some may already be transferred to the rank of definite principles, and others are rapidly advancing in probability. The combined results of Comparative Anatomy, Embryology, and Palæontology have already provided ample material for generalisation in certain directions, and the latest discoveries among the early Palæozoic Fishes make known several facts in regard to the primitive characters of fins which it seems impossible to misinterpret.

It is now the prevalent—perhaps universal—belief that the paired fins of fishes, or those which correspond to the four limbs of lung-breathers, are essentially the same in nature as the median fins which fringe the back and tail. This view is supported, not merely by the identity of structure so frequently observed between the paired and median fins, but also by the presence, in certain embryos of sharks and skates, of a transitory ridge of thickened epiblast between the pectoral and pelvic fins on each side, precisely like the original ridge from which the median fin-fold arises. Since the median fins are proved to result from various modifications of a once-continuous fold of skin and its skeletal supports, it is thus not too much to assume that the paired fins have likewise become differentiated from a similar fold, once extending continuously along each side of the trunk. If, therefore, the primitive character of the median fin-fold can be ascertained, and the various phases in its evolution traced, it ought to be possible to discover the mode and order of development of the more modified paired fins.

Through the numerous discoveries of Elasmobranch skeletons in the Carboniferous and Permian Formations of Europe, recently described, and from existing knowledge of many other early fishes, the primitive arrangement of the supports of the median fin-fold is fortunately well ascertained. There is no longer any doubt that the series of parallel vertical rods of cartilage supporting this fin-fold is directly continuous with the series of neural and hæmal arches of the axial skeleton of the trunk. In other words, the endoskeletal fin-supports are identical in origin with the processes of the vertebræ. This is well shown in the *Pleuracanthidæ*, in which the dorsal fin-supports of the caudal region are equal in number to the neural

arches (Fig. 1), while those of the abdominal region are exactly twice as numerous as the arches (Figs. 1, 2).

Again, it is a well-ascertained fact in Palæontology that the median fin-supports of the more primitive fishes are all divided by transverse joints into two or three pieces, as shown in the Pleuracanthidæ (Figs. 1, 2). The distal piece supports the delicate dermal hair-like rays (when present), which are eventually replaced in higher fishes by typical fin-rays. As the dermal fin-rays are developed, the two or three vertical rows of fin-supports gradually become reduced to one; and if not fused together the remnant of this series, instead of retaining its association with the neural arches, finally becomes correlated numerically with the series of dermal rays it supports. The only exception to this rule known to the writer occurs

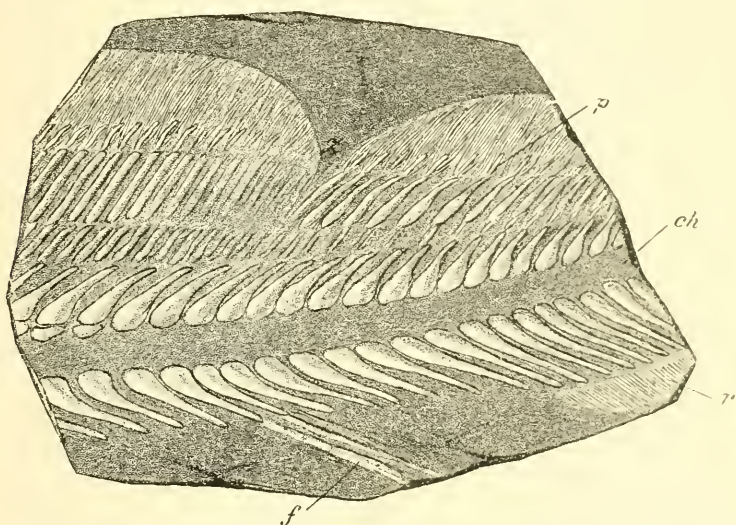


FIG. 1.—Portion of Trunk of *Xenacanthus decheni*, from the Lower Permian of Bohemia
ch. Position of notochord; *f.* Anal fin; *p, v.* Dorsal and ventral portions of caudal fin.
After A. Fritsch.¹

in the caudal fin of some Crossopterygii (e.g., the Cœlacanthidæ), where the fin-supports are equal in number both to the neural and hæmal arches and to the dermal rays.

The atrophy, or "shortening up," of the endoskeletal fin-supports seems to be the invariable result of specialisation in the median fins; and all the higher types of fishes with well-developed fin-rays exhibit the numerical correspondence of the supports, except where secondary fusion of these supports has taken place. The dorsal and anal median fins of such fishes, when not a continuous fold, owe their actual extent to the disappearance, from some unknown cause, of the rest of the fin-membrane, of which the rudimentary series of

¹ We are indebted to Dr. Anton Fritsch for the loan of Figs. 1, 2, 3, 7 and 8, from his well-known work on "The Fauna of the Bohemian Gas Coal."

tapering, rod-like supports is often still preserved between the lateral muscles of the trunk.

There is, however, another method of subdivision of the median fins, specially characteristic of the Elasmobranchii, Crossopterygii, Chimæroidei, and, perhaps, some Dipnoi. At two points in the dorsal region—and never at more or less than two points, so far as known²—there is a tendency towards the crowding and concentration of the endoskeletal fin-supports, usually resulting in the more or less complete fusion of the proximal parts that withstand the growth-pressure, accompanied by the varying fusion of the distal remnants of the mass of supports. At one or two points in the anal region, a similar phenomenon occurs. This is illustrated, to

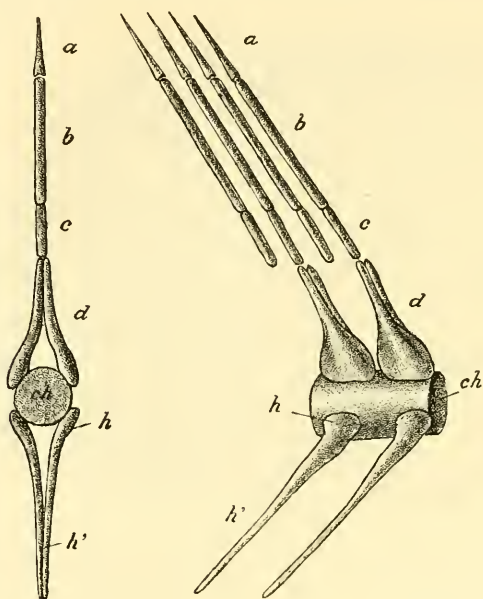


FIG. 2.—Abdominal vertebral segments of *Pleuracanthus*. *ch*, Notochord; *d*, Neural arch; *h*, Hæmal arch; *a*, *b*, *c*, The three series of dorsal fin-supports. After A. Fritsch.

some extent, by the accompanying drawing of the anterior anal fin of *Xenacanthus* (Fig. 3), in which two hæmal arches (*b*, *c*) directly support the crowded and modified cartilages. A more striking case, however, occurs in the dorsal fin of the Devonian Crossopterygian *Holoptychius* (Fig. 4), in which the basal portions of no less than seven supports are fused into one mass, and remnants of a still greater number are clustered together distally. A further stage in this specialisation is met with in the anterior dorsal fin of the Crossopterygian *Cœlacanthidæ*, where the completely fused triangular base alone remains, the distal remnants of the supports are lost, and the dermal fin-rays are

² The apparent exceptions of *Notidanus* and *Chlamydoselache* require examination.

in direct contact with the "basipterygium," reminding one precisely of the pelvic fins of a modern bony fish.

To sum up:—

- (i.) The median fins are primitively supported by a series of rods, in continuation of the series of neural and hæmal arches of the axial skeleton of the trunk.
- (ii.) The supporting rods gradually become atrophied as the dermal fin-rays develop, and are correlated in number with these rays in the higher fishes.

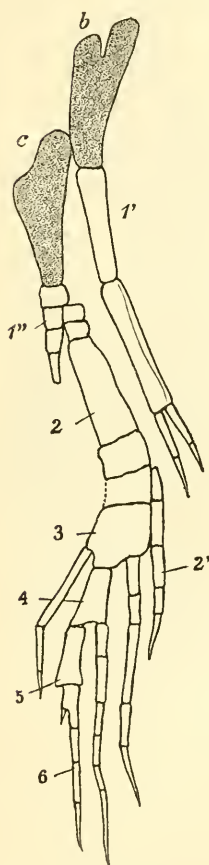


FIG. 3.

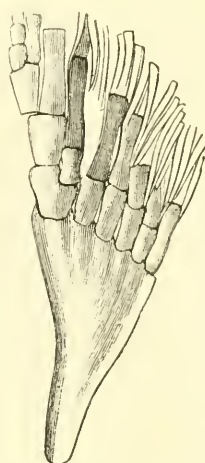


FIG. 4.

FIG. 3.—Anterior anal fin of *Xenacanthus decheni*. *b, c*. Hæmal arches. After A. Fritsch.

FIG. 4.—Posterior dorsal fin of *Holoptychius* (*Glyptolepis*) *leptopterus*, from the Old Red Sandstone of Nairnshire, showing traces of dermal rays distally. From the Catal. Foss. Fishes, Brit. Mus., pt. ii.

- (iii.) The sub-division of the once-continuous fin results either (a) from the loss of portions of the dermal membrane and the subsequent degeneration of the supports; or (b) from the crowding together of the supports at two points in the dorsal region, and at one or two points in the anal region.

Now, to apply these results to the case of the paired fins. If the hypothetical primitive lateral fin-fold on each side was originally supported by a series of parallel rods of cartilage directed outwards,

no pectoral or pelvic fin hitherto described retains the arrangement. The well-known paddle of *Ceratodus* and of the Pleuracanth Sharks (Fig. 7), with its median axis and double series of divergent branches, has hitherto been the nearest approach to the primitive type; and this was at first regarded as the "archipterygium" by Gegenbaur. Within the last few years, however, several specimens of a peculiar elongated Elasmobranch, with *Cladodus*-shaped teeth, have been discovered in the Cleveland shale at the base of the Carboniferous Formation in Ohio, U.S.A.³; and, in the opinion of the present writer, the pectoral fin of this shark at last reveals one of the least-modified

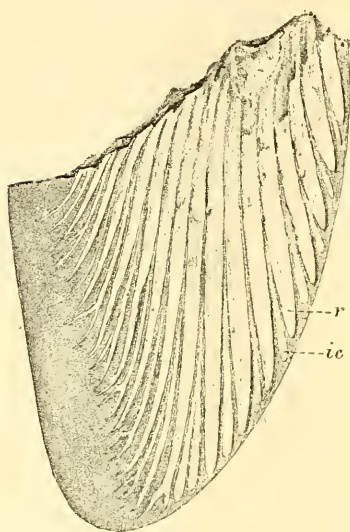


FIG. 5.

FIG. 5.—Pectoral fin of "*Cladodus*" *fylevi*, from the Lower Carboniferous of Ohio. *r*. Complete rays; *ic*. Intercalated remnants of rays. Right border preaxial. From a specimen presented to the British Museum by Dr. J. S. Newberry.

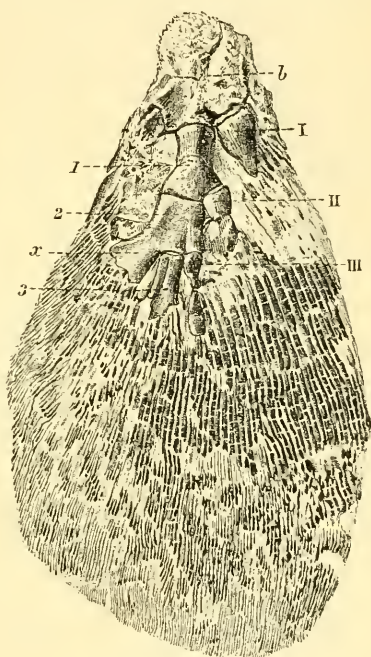


FIG. 6.

FIG. 6.—Pectoral fin of *Eusthenopteron foordi*, from the Upper Devonian of Canada. *b*. Basal cartilage of fin. Right border preaxial. Specimen in British Museum.

conditions of the endoskeleton of the lateral fin-fold that can be expected in a fish in which this fold is already sub-divided into its ordinary two remnants. No fused basals can be detected with certainty in any of the specimens the writer has examined; and, as shown in the fin represented in Fig. 5, none of the parallel cartilaginous rods that support the fin-membrane are transversely jointed. The most singular feature of the fin consists in the evidence it affords of that crowding and concentration we have already

³ See photographs by J. S. Newberry, in Monogr. U.S. Geol. Survey, No. xvi., pls. xlv.-xlvi.

observed in the differentiated median fins of the earlier fishes. Between the extremities of the unaltered parallel bars (*r.*) there are the remnants of similar bars (*ic.*) that have evidently been reduced and displaced by growth pressure, just as a middle digit sometimes becomes reduced and displaced from connection with the carpus in *Ichthyosaurus*, some marine mammals, and birds. Most of the cartilages bifurcate a little distally, but that is a minor matter. The segmentation of the rays, the persistence of one of the middle rays, with the concomitant partial fusion of the still further crowded and reduced bordering rays, would soon, in the writer's opinion, result in the "archipterygium" of Gegenbaur. It is, moreover, significant

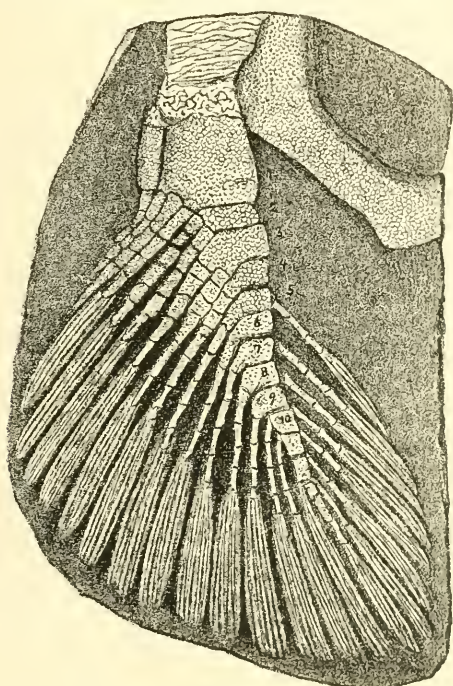


FIG. 7.—Pectoral fin of *Xenacanthus decheni*, showing dermal rays. After A. Fritsch. The left border is preaxial, the right border postaxial. In this interpretation the present writer is directly opposed to Dr. Fritsch.

that the anterior (preaxial) rays are much more robust than the posterior (postaxial) rays, exactly as in all known examples of the "archipterygium."

Whether or not the biserial "archipterygium" results from the crowding of the parallel cartilaginous rays as now suggested, or whether it arises much like the dorsal fin of *Holoptychius* (Fig. 4), as supposed by Dr. Anton Fritsch (Fig. 8), Palæontology appears to have demonstrated that this is the type of paired fin from which all later forms have been derived by abbreviation. Among Crossopterygian Ganoids, the Holoptychiidæ are admitted to rank below the

Rhizodontidæ, and these again below the modern Polypteridæ. In the first family, the pectoral "archipterygium" is as much elongated as in *Ceratodus*; in the second family, which survived after the first had become extinct, the same fin still shows the branched arrangement of cartilages (Fig. 6), but is much abbreviated; while in the

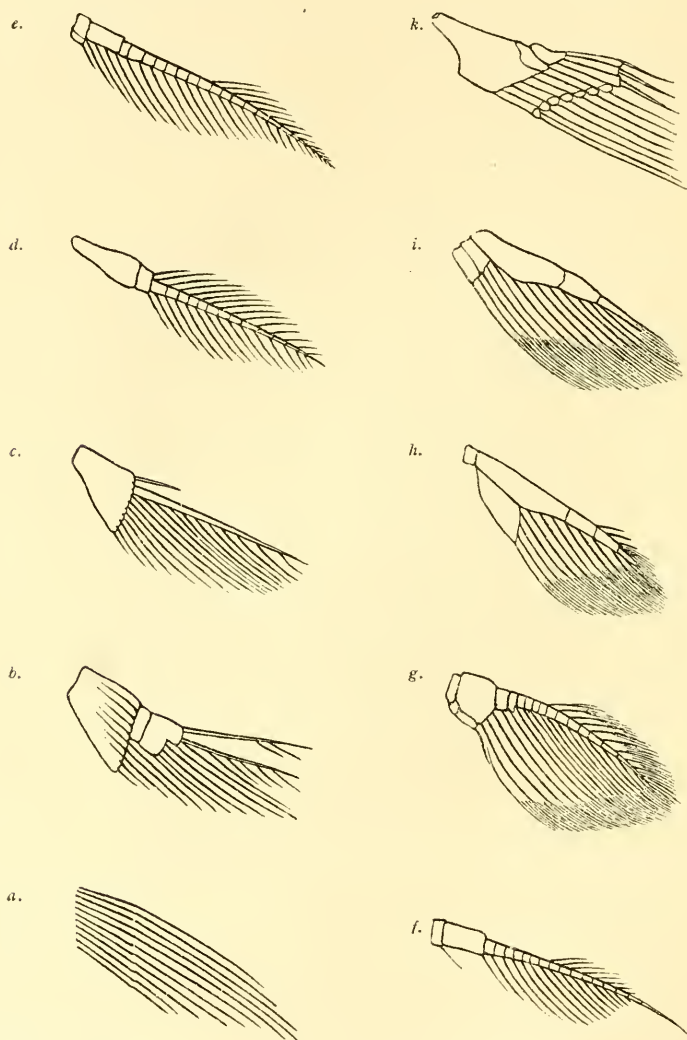


FIG. 8.—Series of Diagrams illustrating the views of Dr. Anton Fritsch in regard to the stages in the Evolution of the Paired Fins.

- | | | |
|---|---|---|
| a. Hypothetical primitive fin. | e. Pectoral fin of <i>Orthacanthus</i> . | figs. with fringing dermal rays). |
| b. Atavistic pelvic fin of aged female <i>Xenacanthus</i> . | f. Pectoral fin of <i>Plewacanthus</i> . | h. i. Pectoral fins of recent Sharks. |
| c. Pelvic fin of young female <i>Plewacanthus</i> . | g. Pectoral fin of <i>Xenacanthus</i> (this and the following | k. Pelvic fin of Sturgeon (<i>Acipenser</i>). |
| d. Pectoral fin of <i>Ceratodus</i> . | | |

recent Polypteridæ, this short lobate fin is almost or quite tribasal, as in a typical modern shark. Among Elasmobranchii, the Carboni-

ferous and Permian genera *Xenacanthus* (Fig. 7 and Fig. 8, g) and *Pleuracanthus* (Fig. 8, f) also demonstrate how, by abbreviation and by the atrophy of the rays on the hinder (or postaxial) border, the same change has taken place; and clearer proof of the identity of the Selachian metapterygium with the axis of the so-called "archipterygium" can scarcely be required.

In short, so far as the facts of Palæontology are known, the evolution of the paired fins is essentially similar to that of the median fins; the only difference being that, while there are two different modes of reduction in the latter, the crowding of the fin-supports at two definite points is the sole process in the former. During this process, until the "shortening up" of the fin-supports begins, there is a tendency towards the contraction of the base of the fin to its narrowest limits; as soon as the shortening has made considerable progress, the basal portion again becomes relatively broad—in the pectoral fin, tribasal or polybasal. Just as the dermal rays in the median fins arising thus are never correlated numerically with their supports, so also the rays of the paired fins never bear any numerical relation to their basal cartilages. The results being the same, the causes are presumably the same; and it is an interesting problem to determine why both the dorsal fold and the lateral fold, when subdivided by concentration, invariably persists only at two points.

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A. SMITH WOODWARD.

IV.

Some Salient Points in the Study of Mammals during 1891.

THE selection of certain points for special notice in the zoological work of any particular year is always a somewhat invidious task, and nowhere is it more so than in the case of mammals. The past year will, however, long be marked as a memorable one in the annals of the Mammalia, as being the one in which our first definite information was acquired as to the structure and affinities of the Marsupial Mole (*Notoryctes*) from the deserts of Central South Australia, the existence of which was first recorded in 1888. Such an important addition to the living Mammalian fauna of the world has not occurred since the publication, in 1860, of M. Du Chaillu's description of the West African insectivorous mammal *Potamogale*; both that genus and *Notoryctes* being the sole representatives of special families in the groups to which they respectively belong. Important as the addition of the Marsupial Mole to the ranks of the mammals undoubtedly is, yet the creature is not of the supreme interest which the preliminary notices, published in 1888, led some naturalists to think might prove to be the case. There were, indeed, suggestions in those notices of affinity with some of the small fossil mammals of the Jurassic rocks of Europe; and it was even doubtful whether the creature would turn out to be a Monotreme or a Marsupial, or something between the two.

Dr. Stirling's account¹ of *Notoryctes* leads us, however, to believe that the animal must certainly be included in the Marsupial order; where it would seem that it should form the representative of a distinct family in the so-called Polyprotodont sub-order of that group, or that which includes the Opossums, Bandicoots, Dasyures, Thylacine, &c. In the original description, beyond the bare reference of the animal to the Marsupials, nothing definite is said as to its exact serial position; but this deficiency has been made good by Mr. J. D. Ogilby, who, in his "Hand-List of Australian Mammals,"² places the family Notoryctidæ among the Polyprotodonts. It is true, indeed, that the last-named writer considers that in the Marsupial Mole "we

¹ *Proc. Zool. Soc.*, 1891, pp. 327-329; and *Trans. Royal Soc. S. Australia*, 1891, pp. 154-187, pls. ii.-ix.

² 8vo, Sydney, 1891.

have at last obtained a definite connecting link between the Monotremes and Marsupials ;" and he is even inclined to think that the creature will eventually have to be placed in the former group, now represented, as we may remind our readers, solely by the Duck-bill and the Echidnas. We fail, however, to detect any marked signs of affinity with the latter group ; the large size of the clavicles, and the abortion of the "marsupial," or epipubic bones, on which stress has been laid, not being characters of any ordinal importance.

Having said thus much as to the affinities of this strange creature, our readers who have not had the opportunity of studying the original papers will naturally expect a few words as to its appearance and habits. In length the new Marsupial Mole measures a little over six-and-a-half inches, of which the tail takes rather more than an inch. Its long and silky hair is of a golden red tint ; while the general form of the body is mole-like (Fig. 1). It has no externally visible eyes, neither is it provided with distinct conchs to the ear. The short and stout limbs are adapted for digging, and are each furnished with five digits. Whereas, however, the digits of the hind limb (Fig. 2, Nos. 4, 5) are sub-equal in size, in the fore limb (Fig. 2, Nos. 1, 3) the claws of the third and fourth digits are enormously developed, so as to form powerful digging

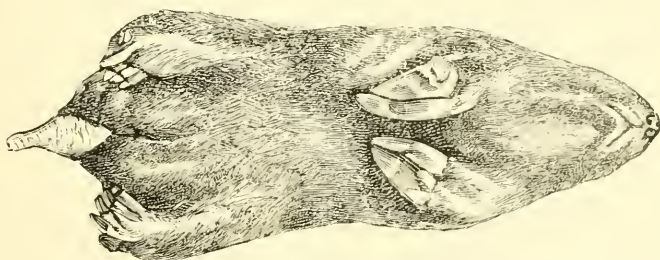


FIG. 1.—Under surface of the Marsupial Mole (*Notoryctes typhlops*). $\frac{3}{4}$ natural size.
After Stirling.³

organs, behind which the small claws of the other digits are concealed. The muzzle of the animal is protected by a curious flat horny shield, divided by a transverse ridge into two moieties ; and the tail is a strange, leathery appendage, marked by conspicuous rings, and terminating in a kind of knob. The teeth—especially those in the anterior portions of the jaws—are small and feeble ; the hinder ones being of that primitive type known as the tritubercular, that is to say, those of the upper jaw carry three distinct cusps arranged in a triangle, with the apex directed inwardly.

Notoryctes lives in or on the sand of the Australian deserts, burrowing at a short distance beneath the surface, and emerging for a time after travelling for longer or shorter distances below. When entering the sand afresh, it starts in an oblique direction. The horny shield on the nose serves as a protection to the conical snout in

³ We are indebted to the Publisher of *La Nature*, Paris, for this and the following figure.

burrowing; but the chief actual work is performed by the two large claws of the fore limb, while the sand is thrown backwards by the hind feet, so as to completely block up the tunnel after the animal has passed. The food of *Notoryctes* doubtless consists of the small invertebrate animals found in the desert sand.

The zoological world will look forward with great interest to the discovery of the mode of reproduction of this latest addition to the Marsupial order.

Although of infinitely less morphological importance than the Marsupial Mole, a considerable amount of interest attaches to the discovery, during the past year, of an entirely new type of Gazelle from Somali-land. So different, indeed, is this animal from all other gazelles that it has been described⁴ as the representative of a distinct genus, under the name of *Ammodorcas clarkei*. Our readers may be aware that, with the exception of the aberrant Gerenuk (*Lithocranius walleri*) of Somali-land, the whole of the gazelles hitherto known are,

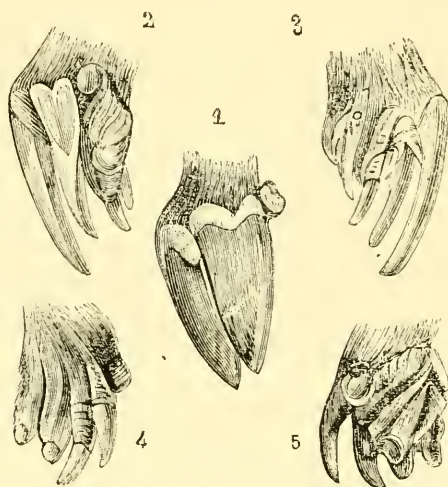


FIG. 2.—Feet of the Marsupial Mole. About $\frac{2}{3}$ natural size. 1. Outer aspect of left fore foot. 2. Profile view of same. 3. Inner aspect of same. 4. Upper surface of left hind foot. 5. Palmar surface of same.—After Stirling.

by common consent, classed by zoologists in the single genus *Gazella*. As a rule, the horns of the gazelles are either lyrate or sublyrate, with their tips bent inwardly. In the gerenuk, or Waller's Gazelle, the horns are, on the other hand, bent forwards at their tips in a distinct hook, so that they are not unlike those of the chamois, if turned the wrong way forwards. There are, moreover, important points of difference between the skull of the gerenuk and those of the true gazelles—notably as regards the much smaller proportionate size of the molar teeth in the former. Now Clarke's Gazelle occupies a somewhat intermediate position between ordinary

⁴ Thomas, *Proc. Zool. Soc.*, 1891, pp. 207–210, pls. xxi., xxii.

gazelles and the gerenuk: the horns curving evenly upwards and forwards, with their basal halves running backwards, and the terminal portions nearly vertically upwards, so that the main curvature is exactly in the opposite direction to that obtaining in ordinary gazelles and the gerenuk. The horns of this curious creature are, therefore, more like those of a Reed-buck (*Cervicapra*) than those of a gazelle; and since the skull presents characters connecting the genus *Gazella* with *Lithocranius*, it is clear that we have in the Somaliland *Ammodorcas* an animal of considerably more interest than the ordinary "new species."

An unusual, if not an unparalleled event in the annals of recent zoology, is the description of a new genus and species based upon a single specimen which is not forthcoming. Such, however, is the case with the new mammal from Sumatra described by Professor Hubrecht⁵ as *Trichomanis hoeveni*. The animal so named was kept for some time in captivity in Sumatra, in which island it was said to have been captured, but was lost on the voyage to Europe. It is described as of the approximate size of a large cat, having a long snout, and a slender cylindrical tongue, frequently thrust out to catch the ants on which the creature fed. The general colour of the fur is said to be grey, with a black stripe down the back; while the tail is described as being bushy, and the claws long and powerful. Such a description reminds us more of the South American Ant-eaters than of any other mammal, and it would certainly be a most remarkable and interesting circumstance if this group were represented in the islands of the Malayan region. We venture, however, to think that zoologists will have some hesitation in admitting this new mammal into their lists until further evidence of its existence is obtained.

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(To be concluded next month.)

⁵ *Nature*, vol. xliv., p. 468, 1891.

V.

English Lake Dwellings.

THE records of pile dwellings in England are not numerous, and by far the most important is the one discovered a few years ago in Holderness by Mr. Thomas Boynton. Other examples have been found, principally in the Eastern counties, where, as in Holderness, meres and morasses were formerly abundant. In 1856, a small sheet of water was drained at Wretham, in Norfolk, and indications of a pile dwelling were found, which were described by Sir Charles Bunbury (1). Ten years afterwards General Pitt-Rivers (2) recorded the occurrence of numerous timbers driven into peat outside London Wall, and in Southwark, together with numerous bones and pottery, mostly Samian, and some Roman coins. An extremely interesting description of the remains is given. The Rev. H. Jones explored a pile dwelling at Barton Mere, near Bury St. Edmunds, in 1867 (3), and Dr. S. Palmer described the discovery of oaken piles dug out of a bog on Cold Ash Common, in Berkshire. In each instance, wooden piles, more or less pointed, were found driven into boggy ground, in some cases, as at Barton, supported by large stones. Associated with them were large quantities of bones of animals used as food, sometimes pottery and implements of bronze or iron. An isolated example of a pile dwelling has been found in Llangorse Lake, in South Wales (4, p. 660), it consists of an island of piles supported by stones, about thirty yards in diameter, in a depth of three feet of water, forming a central platform round which are arranged other piles in groups, from which it is inferred that the dwellings were arranged in groups round a central platform. Bones of the pig, cow, sheep, and horse, with those also of the red deer and wild boar, were found in great abundance. At this period the horse evidently formed an article of food. Some fragments of pottery were found with the bones.

Holderness, the south-eastern portion of Yorkshire, is a low-lying district whose almost uniform flatness is only relieved by occasional rounded hills of gravel and sand. Until about eighty years ago, it was marshy, boggy, and little cultivated; it was then drained, the water being conveyed to the sea by drains at low tide and prevented returning at high tide by an arrangement of sluices. The series of plant-laden semi-stagnant meres, connected with each other by equally sluggish streams, have given place to fertile, highly cultivated plains. The ground is highest near the sea-shore, immense

tracts inland being below the sea level; the natural drainage runs inland, and is emptied into the Humber.

In 1880, the Commissioners of the Beverley and Barmston Drain deepened one of its branches emerging at Skipsca. At Ulrome the drain is cut through one of the ancient meres, and has exposed on its surface the remains of a pile-dwelling. On the eastward edge of the mere is some slightly rising ground which is at the present time twenty-five feet below the sea-level. The pile-dwelling was erected on the shores of the lake and connected with the rising ground adjoining by a pair of large timbers extending parallel with each other, about five feet apart. The upper surface of the timbers is hewn flat, and they have been carefully fixed in position, evidently to form a means of communication between the shore and the platform of the pile structure. The latter consists, at the base, of a number of rough, unhewn trunks of trees, from which the branches have been removed, placed horizontally on the bottom of the lake. They are, in some cases, twenty feet in length, and a foot and a-half in diameter; they extend in an east to west direction, and are held in position by rudely pointed stakes. The addition of timbers placed diagonally against the larger trunks appears to indicate that it may have been necessary to resist the force of a current running in a northerly direction. Between the larger timbers shorter trunks were placed transversely, resulting in a rude but solid and compact framework. This structure, fastened in position by stakes four to six feet in length, driven firmly into the bottom of the lake, forms a rectangular platform thirty yards in length from east to west, and eighteen in breadth in the opposite direction. Oak, ash, birch, hazel, and willow appear to have been used indiscriminately to form the platform. All the interstices between the timbers were filled up level with the top with broken wood and twigs until a level surface was obtained; this, in its turn, being apparently covered with fragments of bark and sand. The eastern end of the platform rests on the gravel shore of the mere, the opposite one is separated from the gravel base by a varying thickness of peat. On the foundation thus securely formed were erected the dwellings of the builders, though no evidence remains of them to-day.

Amongst the bark and sticks of this structure a number of implements and some fragments of pottery have been found. The pottery is dark-coloured, half-baked, and possesses all the characteristics of Celtic origin at an early period. Flint flakes, which may have been used as knives, and for such purposes as cleaning skins, were found. Implements of stone, sharpened or pointed and pierced in the middle, for the introduction of a wooden handle, were used as hammers; picks and hammers were also made from the antlers of the red deer. The large leg bones of the ox, broken diagonally midway between the extremities and pierced near the joint with a circular hole for the insertion of a stick, may have been used as

hoes; the fractured surface is more or less smoothened, and seems to indicate such a use. A large granitoid stone of oval form, exceeding a foot in diameter, with a smooth, flat surface, was found, which may have been used for grinding food; and other smaller rounded and abraded stones were apparently used to pound corn. Numerous hazel nuts were obtained. In addition to the bones of ox, red deer, horse, sheep, dogs, and smaller animals, the jaws of wolves and tusks of wild boars were found. The objects were all obtained from a depth of more than six feet below the surface of the ground.

The excavation proved that the structure which has been described, for some reason or other became untenable, and apparently, after the lapse of a considerable time, a second one was erected above it. The two platforms together occupy a thickness of four to five feet. The newer one is arranged much in the same way as the lower. Timbers are placed horizontally and held in position by piles which not infrequently pierce the timbers of the lower stage, which at that time must have become more or less decayed. The later piles are distinguished from the earlier ones by possessing a long sharp point, and appear to have been shaped by a sharp metal instrument, those of the lower being cut by flint implements. Between the two platforms is an intervening mass of peaty brushwood two feet in thickness, and above the upper one three feet of peat, and one foot of warpy soil connects it with the surface of the ground. Between the two platforms bronze implements have been found, amongst others, a fine spear-head. There is no evidence of iron tools, and taking this fact into consideration it may be reasonably inferred that the latter metal was unknown to the pile-dwellers, and we may approximately form an idea of the period during which the structure was erected. The use of iron was known to the people whom the Romans found occupying the country, and it was probably in use two or three centuries previously; so that the later pile-dwellers must have occupied their abode earlier than the second or third century B.C. The lower structure existed during a period of much greater antiquity.

Since the discovery of the pile dwelling at Ulrome others have been found, and it is probable that they exist in considerable numbers throughout the district.

During excavations made at Preston, in Lancashire, three or four years ago, the Rev. E. Maule Cole found evidences of a pile-dwelling, which were recorded in the *Leeds Mercury*, but so far the matter has not received the attention it appeared to deserve.

Probably the first records of Lake dwellings were made in Ireland, where this method of habitation has been in existence from remote periods to comparatively recent times. There is documentary evidence that some of the Irish Crannogs were in existence and occupied in the time of Elizabeth. They were usually approached in canoes, and were not connected with the shore by a gangway. In

Scotland a large number of similar structures have been discovered. Not very long after attention had been directed to the Irish Lake dwellings, similar erections were found on the shores of several of the Swiss Lakes, and Dr. Ferdinand Keller (4) expended much time and energy in their investigation. Dr. Robert Monro (5, p. 302) has ventured an opinion that the original British Celts, who were probably the builders of the Lake dwellings, were an offshoot of the founders of the Swiss Lake dwellings, who emigrated to Britain and spread northwards and westwards over Scotland and Ireland. On this hypothesis, it is probable that the first settlers would occupy the eastern counties of England, and migrate thence northward and westward. This seems to be borne out by the evidence of the Yorkshire examples, which, if the objects found in them may be considered to indicate the period of occupation, are as early or earlier than those of any other locality in the British Islands.

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VI.

Marine Snakes.

AS in the case of the Mammalia, in which group we find a gradational series from amphibious to absolutely marine animals through such types as the Sea-Otters, the Eared Seals, the true Seals to the Sirenians and Cetaceans, the Reptiles present us with examples of almost every degree of adaptation to marine life. The Galapagos Iguana, living on land, but entering the sea for feeding on sea-weeds; the estuarine Crocodiles and Trionychoids, occasionally wandering miles out at sea, and of which *Crocodilus porosus* and *Pelochelys* are living representatives; the Turtles and Leatherbacks, essentially marine forms, which are, however, compelled to resort to land to deposit their eggs; the extinct viviparous Plesiosaurs and Ichthyosaurs are well-known examples. But no better instance of gradual modification from terrestrial into marine forms could be found than in the Ophidia living at the present day, among which also are to be found the only recent reptilian types that, being viviparous, never leave the water. These snakes are the Hydrophids, or Sea-snakes, and it is with the state of our knowledge of these and some other snakes allied to them in their mode of life, that it is proposed to deal in the present review.

From the time of Schlegel (15) and Duméril and Bibron (5) down to the present day, the Hydrophids, or poisonous marine snakes, have almost universally been regarded as a distinct and perfectly natural family. Their affinity to the Elapidæ, or poisonous terrestrial colubrine snakes had not been overlooked, nor could have been, considering the very striking resemblance which one of them, *Platurus*, bears to *Elaps* and *Bungarus*. But the whole classification of snakes was most artificial, especially when, as has been so often the case, the division into poisonous and non-poisonous groups primed all others. In the recently-published volume of Blanford's Fauna of India dealing with the Reptiles (3) I have abandoned the character of the dentition in the definition of families, and the great group Colubridæ is divided into three parallel series:—The AGLYPHA, in which all the teeth are solid; the OPISTHOGLYPHA, with posterior grooved fangs; and the PROTEROGLYPHA, with anterior grooved fangs. The Hydrophids naturally find their place in the latter division, and, although they are placed together as a sub-family near the Elapinæ, I am far from satisfied that such an arrangement

answers to the aim of modern classification, viz., that it shall correctly express their blood-relationship.

A glance at *Platurus*—and, better still, a comparison of its palato-maxillary arch with the same in the other *Opisthoglypha*—shows it to agree so perfectly with some of the terrestrial *Elapines*, that we cannot resist the conclusion that it should be regarded as one of the latter, which has become adapted to marine life, in the same way as some of the *Aglypha* and *Opisthoglypha* have become modified into such forms as *Chersydrus* and *Hipistes*. For it is a fact frequently overlooked, though ascertained by Cantor (4), Stoliczka (16), Theobald (17), and other naturalists in India, that these harmless snakes are as much marine as the *Hydrophids*, to which they bear so striking a superficial resemblance as to be almost undistinguishable from them when seen wriggling in the fishing nets, or floating or gracefully swimming on the surface of the water. But their tail, although compressed, does not assume the oar-shape characteristic of the *Hydrophids*, nor are the neural and hæmal processes so strongly developed as in the latter. An examination of the scaling of the head also

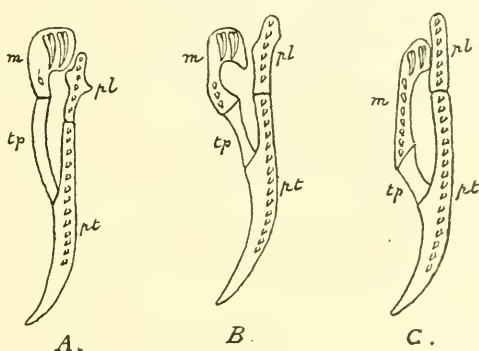


FIG. 1.—Views of right palato-maxillary arch. A. *Platurus*; B. *Enhydis*; C. *Hydrus*.
m. Maxillary; pl. Palatine; pt. Pterygoid; tp. Transpalatine. (From the "Fauna of British India.")

reveals important differences which show these snakes not to have been derived from the same stock as yielded the *Hydrophids*, and, therefore, that the resemblance between the two types is merely due to convergence, the result of adaptation to a similar mode of life.

Then, again, the true *Hydrophids*, and particularly the genera *Hydrus*, *Hydrophis*, *Distira*, although allied to the terrestrial *Elapidae*, are, with regard to the structure of the palato-maxillary bones, so much less specialised that it must be assumed that they arose from some no longer existing colubrine type, of which both the terrestrial and marine forms are the descendants. In this instance, therefore, as in so many others, what appears to form a natural group would be merely an association of converging forms.

The snakes that live in the sea may be referred to four natural groups:—

1. Aglyphous, harmless: *Chersydrus*, one species, inhabiting the mouths of rivers and the coasts of Southern India, Burma, the Malay Peninsula and Archipelago, and New Guinea.

2. Opisthoglyphous, harmless, to man at any rate: *Cerberus*, *Hypsirhina*, *Fordonia*, *Cantoria*, *Hipistes*, altogether about a dozen species found in rivers, and on the coasts of India, Burma, the Malay Peninsula and Archipelago, the Papuan Islands, and North Australia.

3. Elaps-like Proteroglypha: *Platurus*, two species.

4. True Hydrophids: *Aipysurus*, *Acalyptus*, *Pelagophis*, *Hydrus*, *Enhydrys*, *Hydrophis*, *Enhydrina*, *Distira*, about fifty species altogether.

That *Platurus* is not so absolutely aquatic in its habits as the other sea-snakes, was suspected by Günther in 1864 (9), and this supposition has been verified by Jagor (9, p. 209), Bavay (1), and

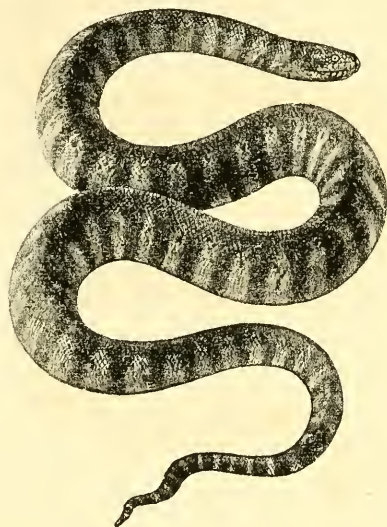


FIG. 2.—*Chersydrus granulatus*, a harmless Marine Snake. (From the "Fauna of British India.")

Hagen (in van Lidth de Jeude, 13). The former traveller found a large specimen on a rocky island in the Philippines, at an elevation of 60 feet above sea-level, and one was obtained by Hagen in the forests of Serdang, Sumatra, at a distance of nearly a day's journey from the sea. It has also been repeatedly observed that *Platurus* may be handled with impunity, never attempting to bite, notwithstanding the deadly poison-apparatus of which it is possessed. Its gentle disposition is well known to the colonists of New Caledonia, and the confidence they have in it led to a fatal accident, which is related in an interesting pamphlet by Dr. Forne (7), one of the medical officers at Noumea. A convict, trusting to his experience of *Platurus*, handled a sea-snake which afterwards proved to be a

Hydrophid (*Distira ornata*, var. *ocellata*); bitten in the hand, the man died nine hours later.

The Hydrophids, on the other hand, are most irascible, and not known ever to leave the water; their movements, when out of that element, being very awkward. In their attempts to bite they will even turn round to wound their own bodies, as observed by Cantor (4), this being partly due to the fact that they are nearly blind in the daytime. S. Kneeland (12) relates his experience with some Hydrophids in Manilla Bay: "We were anchored about three miles from land, in water twenty feet deep. To while away the time we fished, but either our tackle was too clumsy or our bait unsuitable, for we had not even a bite all day. As night came on we kept our lines in the water merely for experiment's sake, without the remotest

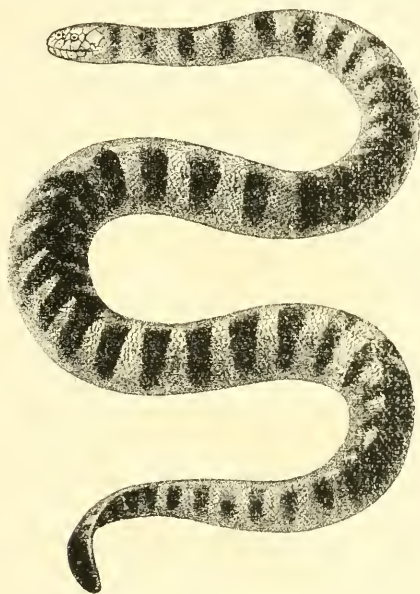


FIG. 3.—*Enhydrina valakadien*, a poisonous Marine Snake. (From the "Fauna of British India.")

idea of catching anything. The sea was calm, and the darkness intense. Between 9 and 10 p.m. we caught six water snakes on hooks of large size, baited with salt pork, and resting quietly on the bottom. They were of about the same size, 3 feet long, . . . and very savage, snapping at everything within their range." That their bite is very dangerous, in some cases even fatal to man, has been established by the experiments of Russell (14), Cantor (4), Fayrer (6), and others. The largest size attained by any of them is about twelve feet.

The home of the marine snakes, whatever their affinities, is in the Indian and Western South Pacific Oceans, being found in abundance from the Persian Gulf, along the coasts of India, Burma, and the Malay Archipelago to North Australia and New Caledonia. Some

species have a very wide distribution; *Hydrus bicolor* occurring throughout the Indian and tropical Pacific Oceans, and the extreme points from which it is on record being the Cape of Good Hope, Posiette Bay (Mantchuria), New Zealand, the West Coast of Mexico, and Guayaquil. Several species extend from the Persian Gulf to New Guinea and North Australia, or from the Bay of Bengal and the Chinese Sea to New Caledonia. One species is stated to be confined to fresh water—*Hydrophis semperi*, from Lake Taal, in Luzon (Garman, 8).

The Hydrophids being most abundant in the Arabian Gulf and the Bay of Bengal, it is in the works dealing with the Fauna of India that the greatest amount of information respecting them is to be found. Günther's "Reptiles of British India" (9), contains a complete account of the species known in 1864; Fayrer's (6) "Thanatophidia" gives effective coloured figures of several species; excellent figures appear in Jan's "Iconographie" (11); whilst a revision up to date of all the species known from the coasts of India, Ceylon, and Burma will be found in my volume of the "Fauna of India" (3). Boettger's notes on secondary sexual characters in *Hydrophis* (2) is another important recent addition to our knowledge of this most interesting group of Snakes.

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G. A. BOULENGER.

VII.

The Exploration of Coral Reefs by Borings.

AFTER the years of controversy upon the respective merits of the opposing theories of the origin of coral reefs, an effort is now being made to apply the test which is generally considered to be the only final one. Considering how much is involved by the coral question, with its bearings on the geological history of the whole Central Pacific area, on the permanence of oceans and continents, on zoological distribution, and on the relation of subsidence to volcanic action, it seems surprising that no attempt has previously been made to secure an adequate series of borings. An influential committee has, however, now been appointed by the British Association to arrange for this to be done. The subject having thus been brought within the range of practical science, one is led to consider the questions connected with the choice of a site that would be accepted by all parties as a good test case, and with the mechanical difficulties that have frustrated previous attempts to apply this method of investigation.

In the selection of a test locality, it is obvious that the Darwinians should have the main voice, for there are many cases where reefs occur on submerged banks and shoals, and where a boring would be an absolute waste of money. It is, therefore, for the believers in the subsidence theory to point out a reef where this chance is reduced to a minimum. Fortunately, there are plenty of data with which to do this. Darwin himself remarked that the smallness of many coral islands is an argument for subsidence, and Dana has clearly indicated the characters by which a sinking reef may be distinguished from one that is stationary. In the latter, the *débris* from the reef would accumulate as a beach around the island and thus increase its size; the slopes around the beach-line would be made steeper; storms would throw material into the lagoon and fill it up; and the island would tend to become well wooded. On the other hand, a sinking reef would decrease in size; the lagoon would rarely be more than partially filled up; the surface of the island would rise but slightly above the sea; and it would be largely tide-washed, and thus kept free from trees. Further, Dana has shown that the islands of these two classes are distributed on a definite plan, which affords, probably, the strongest argument for the subsidence theory.

To take one case: at the east end of the Paumotu Archipelago the coral islands are well-wooded, have broad reef grounds, and their lagoons are filled up; that is to say, they possess the characters of stationary reefs. Going westward, the islands are seen to decrease in size and elevation; the lagoons persist, and the islands become less and less wooded. At Bellingshausen Atoll the last stage is seen, and beyond this there is nothing but open sea for nearly 900 miles; then some low banks of tide-washed coral commence the Samoan Archipelago, in which the order is reversed, till it culminates in the great wooded coral island of Savaii. The inference is that the central open sea represents an area where subsidence was too rapid for the reefs to keep pace with it, and so they have been submerged, while the gradual increase of the reefs on either side marks the decrease in the rate of subsidence. If this deduction be correct, then, by the application of this method, one can map out the whole of the Central Pacific into subsiding or stationary districts. Broadly speaking, there are two main lines across the Pacific, along which the land is either rising or is at least stationary. The first runs as a continuation of the longer axis of New Zealand, north-eastward through the Kermadec and Tonga Islands, to the volcanoes of the Samoans, and thence past the Phoenix group and the Kingman Shoals to the Sandwich Islands in the extreme north-east. Along the whole of this line there occurs a chain of volcanoes, a submarine ridge, occasional shoals, and islands with raised reefs, and some plutonic rocks. The second line starts from the coast of South America, as the submerged plateau that extends for a great distance north-west of Patagonia, and runs thence through the Paumotu group, crossing the other line almost at a right angle at the Samoans, and thence it continues westward as the main chain of Malaysia. Parallel to these two lines, and on both sides of them, are areas of deep and open sea, which certainly seem to represent areas of subsidence. It is in one of these that the greatest expanse of radiolarian deposits occurs, stretching as a great elliptic sheet trending north-east and south-west; where this crosses the second line it is completely cut across by a band of a less abyssal globigerina ooze, as is well shown in the beautiful map of the distribution of the deep-sea deposits which accompanies the last volume of the "Challenger" Reports.

It is manifest that any boring on one of the stationary or rising lines would be quite valueless, as shallow reefs might occur anywhere along them. The islands that are most likely to yield a conclusive result are the low atolls on the very margins of the great coral archipelagos, such as Enderbury Island at the northern end of the Phoenix, Rose Atoll at the eastern end of the Samoans, or Bellingshausen Island at the western end of the Society group. But these atolls are so very inaccessible that some more convenient locality would naturally be preferred. Diego Garcia, for example, or any of those in the Indian Ocean, would be much more easily reached. But it is

not at all improbable that the Maldives and Laccadives occur along a submerged ridge that runs parallel to the line of the Western Ghats, and the southernmost peak of which is marked by Diego Garcia. Hence the selection of this atoll might easily mean the failure of the experiment, for if the reef in this case should be found to be only a thin cap, it would simply prove the existence of this submerged chain, and not that the subsidence theory is unnecessary for the atolls of the Pacific. The Central Pacific is the typical coral reef area, and it is to be hoped that it may be possible to select this region for the experiment. Its proximity to the Australian mining fields is also in its favour, as machinery might easily be obtained thence.

The mechanical difficulties in the way of a deep boring are, however, especially serious on the small low atolls. The upper crust of the coral rock is sure to be more or less rotten and perforated by irregular cavities and channels. Hence, as soon as the work has been well started, the weight of the machinery and the vibration of the boring cylinder are not unlikely to cause a slight subsidence and the breaking of the tool. The attempt made by the Tuscaroa failed in this way. But the difficulties, though serious, do not appear to be insuperable, and if the site be selected with sufficient care, and a proper foundation be erected, there seems no reason why a 500 or a 1,000 foot core should not be obtained.

Finally, in regard to the nature of the core: to judge by many of the remarks made upon this question, some writers seem to expect that, if the subsidence theory be true, the whole core should be of solid coral. But an examination of the structure of raised reefs clearly shows that this cannot be expected. The extensive excavations in the Barbados reefs, made by the Barbados Water Co., has thrown much valuable light upon the varying composition of coral rocks. A large collection of these rocks has been presented to the British Museum by Mr. E. Easton, and this has been supplemented by donations from Professor Harrison and Mr. Jukes-Browne. Microscopic examination of the specimens in this considerable collection shows that the reefs consist mainly of coral-sand and *débris*, with beds of limestone formed by nullipores, foraminifera, mollusca, &c., as well as by corals. In many cases, too, there are masses of rock without any trace of organic structure, though they have been unquestionably formed from corals. The rock of which the atolls are composed is likely to show similar variations; and as the whole foundation of the reef is probably saturated with sea water, it is quite possible that, below a very limited depth, the rock will consist only of a jointed, crystalline limestone. But even if this be the case, microscopic examination will, no doubt, be able conclusively to demonstrate whether the rock was formed at the depth where it was found, or whether it was a shallow water deposit that has since subsided.

J. W. GREGORY.

VIII.

Some Recent Researches on Insects and Arachnids.

THE greater part of entomological literature consists of descriptions of new genera and species. To record the names of these would be foreign to the purpose of this Review, which will not endeavour to do the work of the "Zoological Record." "Species making" has often been condemned by morphologists as an unprofitable pursuit; and no doubt the naturalist whose highest ambition is to describe as many new forms as he possibly can, has fallen far short of the ideal which the true student of animal life should set before him. Yet the work of discriminating species is a necessary one; and the generalisations of the philosophic naturalist must largely depend on the technical labour of the systematist.

Only newly described forms which have an evident biological interest will be referred to in this notice. Our object will be to gather from the mass of current entomological literature those results which throw light on the history of the various insect groups. The latest discoveries in anatomy, development, habit, and adaptation to environment will, as far as possible, be recorded.

A contribution to Arachnid anatomy has lately been made by Dr. P. Bertkau ("Zool. Anzeiger," vol. xv., p. 10), who describes sense organs found on the upper side of the last joint of the palps and first pair of legs of two species of Solpugidea (*Solpuga flavescens*, C. L. Koch, and *Galcodes barbarus*, Luc). These organs are of two kinds, and resemble those already described as found on the antennæ of ants and other insects. On account of their shape, they have been styled "champagne-cork" and "flask-shaped" organs. They are in communication outwardly with small openings in the chitinous body-wall, and inwardly with ganglion cells and nerve-cords. Dr. Bertkau thinks it probable that their function is that of smell.

Some notes of interest have appeared in the English entomological journals on the effect of environment on the development of Lepidoptera. Mr. R. Adkin ("Entomologist," vol. xxv., p. 25) states that the wet and cold summer of last year caused a prolongation of the larval and pupal stages in several species over the normal periods. Mr. F. Merrifield ("Entom. Monthly Mag." [2], vol. iii., p. 20) gives the results of four years' experiments in rearing spring-

feeding caterpillars of *Selenia tetralunaria*, some on trees in the open air and others on cut food indoors. Those treated in the former way completed their development in the summer as usual; but the house-fed larvæ, though they pupated in good time, did not become moths until the following spring. Thus, a normally double-brooded species was made single-brooded by being fed indoors, whereas the high temperature of a house should have had just the opposite effect to this. Mr. Merrifield finds in the condition of the food the explanation of this anomaly. He believes that feeding on cut branches wanting moisture, and with little circulation of sap, must have a retarding effect on the development of the insects.

An interesting account of the way in which the caterpillar of *Acronycta alni* makes its cocoon is given by Mr. M. Fitzgibbon ("Entomologist," vol. xxv., p. 40). The habit of this larva is to select a rotten stick, which it proceeds to hollow out, in order to form a shelter wherein it may winter in its pupal stage. The noteworthy point of the description is the use of the caterpillar's strong bristles in sweeping away the sawdust formed by excavation. These bristles are flattened at the tip, and seem specially adapted for this function.

In the same paper the colouring of this caterpillar is discussed. In its early stages, it is supposed to be imitative of a bird-dropping, but after the last change of skin it becomes conspicuously adorned with warning-colours. Like many other larvæ, it hides from its enemies until it is too large to be hidden any longer, and then it tries to frighten them away.

An important contribution to Insect Embryology has been lately made by Dr. R. Heymons, of Berlin ("Zeitschr. für Wissensch. Zoologie," vol. liii., p. 434, &c.). This is a paper entitled "Die Entwicklung der weiblichen Geschlechtsorgane von *Phyllodromia* (*Blatta*) *germanica*, L.," which gives a very exhaustive account of the origin and formation of the ovaries and oviducts in that household pest known as the German Cockroach. This insect is a smaller and paler species than the Common Cockroach (*Periplaneta orientalis*), which it is said to be supplanting in many places in Britain, where it has succeeded in establishing itself. In his introduction, Dr. Heymons points out that technical difficulties have hitherto prevented a complete study of this subject. The eggs of the cockroach are enclosed in a chitinous capsule, and the yolk-mass contained in each egg is of a nature unfavourable for microscopic investigation of the early stages of development. These obstacles have now, however, been successfully overcome. The cockroach is an insect of a primitive and generalised type, and its development is not complicated by secondary metamorphic adaptations; hence it is specially valuable for embryological research.

The primitive germ-cells arise from the mesoderm, from the ordinary cells of which they may be distinguished by their larger size. They first appear towards the hinder end of the blastoderm, before the formation of the somites. They are also formed, however,

from the walls of the somites as these are developed, and, in the younger stages of the embryo, are always to be found in the second, third, fourth, and fifth abdominal segments. Thus, whether formed from the primitive layer, or from the coelomic epithelium, the origin of the germ-cells is clearly mesodermic.

This result is contradictory to that lately obtained by Cholodkovsky, who believes that the germ-cells are probably formed from small yolk-cells. Dr. Heymons, however, has no doubt that the Russian observer fell into error owing to the imperfection of his method of preparation, especially as he was unable to distinguish the germ-cells before the stage at which the somites begin to form.

Certainly the mesodermal origin of the germ-cells seems by far the more probable of the two alternatives, and, after a review of the results obtained by workers in other insect groups, Dr. Heymons concludes that, among insects generally, though sometimes in a modified way, the mesoderm gives rise to the generative organs. In the origin and segmental arrangement of the germ-cells he sees a similarity to what is observed in the Annelids.

As development proceeds, the somites become largely filled up with the fat-body, and the germ-cells begin to take up a dorsal position. The differentiation of sex is now evident. Epithelial cells of mesodermal origin arrange themselves around and amongst the germ-cells. The epithelial cells ventral to the germ-cells form the oviduct, those dorsal to them arrange themselves in linear series to form the thread-like ends of the ovarian tubes, whilst others enclose the germ-cells and so form the ovarian tubes. Special attention is called by Dr. Heymons to the fact that, throughout the course of the development, the germ-cells are always quite distinct from the epithelium of the ovary.

During the larval stages, changes take place in the nuclei of the germ-cells, and they begin to assume the characters of ova.

The thread-like prolongations of the ovarian tubes appear to be of use only during the embryonic and larval periods, and their function is to enable the ovaries to change their position in the body of the insect. They are all continuous with a single thread of cells which stretches to the pericardial septum.

Dr. Heymons states that the contents of the ends of the ovarian tubes are ordinary epithelial cells and germ-cells. These portions of the tubes in different insects have been called "Endkammer" by various authors who have described a mass of undifferentiated cells as found in them. In *Phyllodromia*, however, the germ-cells are, as stated above, all along distinct from the epithelial cells.

Some statements have lately been made with regard to the effect produced by the parasitic Stylopidae on their hosts, which are Bees, mostly of the genera *Andrena* and *Halictus*. Mr. R. C. L. Perkins ("Entom. Monthly Mag." [2], vol. iii., p. 1) gave as the result of his investigations on stylopised bees that the internal organs of the hosts

were hardly affected by the presence of the parasites, and that the males certainly, and the females probably, were still capable of reproduction. These results are extremely surprising, being in direct contradiction to those obtained by Shuckard, Westwood, and Perez. The last-named of these, a few years ago, gave a very full account of styloped bees ("Actes Linn. Soc., Bordeaux," vol. xl., p. 21). Mr. F. V. Theobald, however, confirms, to a great extent, the work of these older observers ("Entom. Monthly Mag." [2], vol. iii., p. 40), and makes it likely that the specimens examined by Mr. Perkins were of a very exceptional nature. The *Stylops*, lying above the viscera, obtains its nourishment by osmosis through the abnormally thin walls of the alimentary canal, which, being forced down on the reproductive organs, renders them abortive. They do not, as a rule, contain ripe ova or spermatozoa. Indeed, Mr. Perkins admits that he could not find the former in any styloped female.

The habits of another class of parasites are described by Herr C. Verhoeff ("Zool. Anzeiger," vol. xv., p. 41). These are bees of the genus *Stelis* which have long been known to lay their eggs in the nests of other bees (*Osmia*). Former observers had noticed the eggs both of the parasite and of the host in the food-mass in the cell, and at a later period had found only the larva of the *Stelis*. Hence it had been inferred that the *Osmia* grub died of starvation. It seems, however, that its death is really due to violence. The *Stelis* lays her egg before the *Osmia*, and at the further end of the food-mass, whilst the *Osmia* lays her egg on the surface of the food-mass. Hence the two eggs are at opposite ends of the food; and both grubs feed for a time without conflict. Later, however, the *Stelis*, which, being older, is larger and stronger than the *Osmia*, attacks the latter, digs its mandibles into the head of its victim, kills, and devours it. The time occupied by the *Stelis* larva in eating up the *Osmia* is one to two days.

It seems doubtful if this habit is one to which the term parasitism can properly be applied.

G. H. CARPENTER.

IX.

The Relationship of the Carboniferous Plants, *Sigillaria* and *Stigmaria*.

THE true nature of *Stigmaria* has long been a fruitful subject of discussion among palæophytologists. Brongniart, who appears to have first established and defined the genus, describes the specimens so named as stems bearing leaves, which ultimately disarticulated and left the surface marked by scars arranged in a quincuncial order.¹ He seems to have had some knowledge of the internal structure of *Stigmaria*, and on the strength of this and other features placed it, with some reservation, amongst the Lycopodiaceæ, pointing out that it had many points of analogy with the existing genus *Isoetes*, and suggesting that it might be considered as a gigantic aquatic Lycopodiaceous plant, in fact, a sort of arborescent *Isoetes*. The subsequent discovery by Binney and others of fossil *Sigillariæ* and *Lepidodendra*, whose trunks were continued downwards at the base into large, spreading, and bifurcating structures recognisable as *Stigmaria*,² soon gave rise to another view of their morphological nature, viz., that they were in reality the roots of these trees, and not the stems of independent plants as had been generally supposed. From that time to the present, opinions have been divided as to which of these two views was the correct one, and as new facts have been brought to light, the advocates on either side have sought to interpret them in accordance with the opinions they hold. After carefully weighing the whole of the evidence available five years ago, Count Solms-Laubach came to the conclusion³ that the best explanation of the known facts was to be found in the hypothesis that the *Stigmaria* were rhizomes adapted to a soft pulpy environment, whose appendages, though probably foliar in their nature, were functionally organs of absorption.

On the assumption that this conclusion was correct, the further question presented itself as to how the aerial *Sigillaria* with its Stigmarian rhizomes was developed. Was it to be supposed that

¹ "Prodrome d'une Histoire des Végétaux fossiles," 1828.

² For details of these discoveries, &c., see Williamson, *Stigmaria ficoides*, *Palaontographical Society*, 1887; also Solms-Laubach, "Fossil Botany," Clarendon Press

³ "Fossil Botany," pp. 291-293.

the *Sigillaria* gave rise to the *Stigmaria*, or *vice versa*? To this question, so far as I am aware, no satisfactory answer was given, and its solution was left over until further investigations should throw fresh light upon it.

Some such light appears to have been obtained by Professor Grand' Eury, who has recently written an elaborate memoir on the *Géologie et la Paléontologie du Bassin houiller du Gard*, in which the subject is dealt with. Unfortunately, this memoir will only be accessible to a very limited number of workers. Printed under the auspices of the colliery companies of the district dealt with, only 125 copies have been struck off, and these, it is understood, will not be obtainable by purchase, but disposed of in another way. M. Zeiller, however, in presenting, on behalf of the author, a copy of the memoir to the *Société géologique de France*, has given a careful and somewhat lengthy summary of the palæontological portion, and has thus ensured for the main results a much wider publicity than they would otherwise have obtained. So far as these bear upon the morphological character of *Stigmaria* and its relation to the aerial stem of *Sigillaria*, they are embodied in the following paragraphs, for the substance of which I am indebted to M. Zeiller's excellent summary.

In the first place, it may be noted that Professor Grand' Eury, like Count Solms-Laubach, has come to the conclusion that *Stigmaria* are rhizomes which floated in water or spread themselves out on the surface of mud. In this condition they were able to live on indefinitely without giving rise to an aerial stem. But his observations have led him much further than this, and have enabled him to indicate, at least in a general way, the mode in which these creeping rhizomes gave origin to aerial stems. The first step in the process is the knotting up of the *Stigmaria*, so to speak, in order to form a large bulb. M. Zeiller does not state whether this bulb-formation takes place at the growing tip of *Stigmaria* or at some other point, or whether both cases are possible. However this may be, the connection is said to be of such a nature that the bulbs are united to the *Stigmaria* by a vascular axis. At first, the bulbs present four swellings at the base, but these afterwards elongate, and ultimately show the cruciate disposition so often recorded as characteristic of the bases of the stems of *Sigillaria*. At first, neither the upgrowing stem nor the root-like branches carry any appendicular organs, and consequently their surfaces are not marked with the usual characteristic scars. Thus the lower part of the bulb, in developing and branching, takes the form of *Stigmariopsis*, while at the same time the stem begins to raise itself vertically. At the base of the stems arising in this way, and which are often swollen into the shape of a bottle, M. Grand' Eury has observed neither true foliar scars nor any trace of a vascular bundle, but merely a number of glands arranged in pairs. Thus, the base of the aerial stem has the characters of the fossils known as *Syringodendron*, or rather those properly so-called, viz., those of the type of *Syr. alternans*, which

M. Grand' Eury now regards, not as decorticated *Sigillaria*, but the part of the stem which stood in the water or mud, and was destitute of leaves. This part, according to circumstances, might remain short or attain a height of several metres. Higher up the trunk, the leaves made their appearance, but the first to be developed were very short, and were perhaps rather of the nature of scales.

In this account of the development of *Sigillaria* with its Stigmarian rhizomes, there are obviously many lacunæ, which may be due to the condensation necessary in M. Zeiller's paper. Nothing is said, for instance, of the fate of the *Stigmaria* when the bulb formed upon it has developed into a *Sigillaria*. This is certain to attract the attention of palæophytologists, and the more so since, in the stumps of *Sigillaria* described in the literature, no trace of such a structure is met with. The four primary rhizomes seen from below have merely a cruciate depression between them, and show no signs of having been attached to a parent *Stigmaria*. On the other hand, the absence of such signs is capable of an easy explanation, and appears to afford no substantial ground for rejecting the views put forward by M. Grand' Eury.

Subject, then, to the needful reservations, it will probably be conceded that the mode of development of *Sigillaria*, as outlined above, is not an unlikely one, and would be more or less consistent with what has long been known of the relations of *Sigillaria* and *Stigmaria*. It will be observed that the account furnishes a more definite conception than has hitherto been possible of the nature of the fossils known as *Stigmariopsis* and *Syringodendron*, and makes more precise the distinction between the former and *Stigmaria* proper. That distinction has not hitherto been received with much favour by palæophytologists generally, but M. Grand' Eury appears to be convinced of its reality. As this conclusion is based upon observations of wide extent—what are termed forests of fossil *Sigillaria* having been opened out in the district investigated—it is, no doubt, entitled to, and will receive, the respectful attention of other authorities. Still, it may be pointed out that in several examples figured or described in the literature, there is no absence of the characteristic scars, even at the proximal ends of the four primary Stigmarian branches into which *Sigillaria* divides at the base. This being so, the possibility is suggested that the *Stigmariopsis* stage may not be a constant feature of the development of *Stigmaria*, but may be in some way dependent upon circumstances, as appears to be the case with the height of the *Syringodendroid* part of the *Sigillarian* stem.

THOMAS HICK.

X.

The Mammals of India.¹

NO more important faunistic zoological work has ever been attempted than the "Fauna of British India," of which the present fasciculus concludes the volume devoted to the Mammals. The need for such a comprehensive work, as we are informed in the preface issued with the part before us, was strongly urged on the Government of India by a representative body of zoologists in a memorial signed in the autumn of the year 1881; and it reflects no little credit on those in authority at the India Office that the considerations urged in that memorial were so promptly answered. The whole work was placed under the able editorship of Mr. W. T. Blanford, whose reputation as a proficient in Indian zoology generally, and as a specialist in several branches thereof, is a sufficient guarantee that it could not have been confided to better hands. At first there was some doubt whether it would be found practicable to extend the work beyond the limits of the Vertebrates, but we are now glad to learn that such limits have not been imposed, and that the volumes descriptive of the Moths are now actually in hand. The promptitude with which the volumes allotted to the Vertebrates have been issued is worthy of all praise, six out of the whole seven being completed by the issue of this second fasciculus of the one devoted to the mammals. We thus have the Mammals, by the Editor; two volumes on Birds, by Mr. E. W. Oates; one volume on Reptiles, by Mr. G. A. Boulenger; and two on Fishes, by the late Surgeon-Major Day. The issue of a third volume on Birds will complete the Vertebrate series.

The first fasciculus of the volume on mammals, which appeared in 1887, contained the description of the various representatives of the orders Primates, Carnivora, and Insectivora; while in the present issue we have the orders Chiroptera, Rodentia, Ungulata, Cetacea, Sirenia, and Edentata, the two remaining groups being unrepresented in the Indian area. We are informed in the preface that the total number of species of mammals now recognised from British India, Ceylon, and Burma, as well as the adjacent seas, just exceeds 400. In Jerdon's "Mammals of India," published in 1867, the number was only

¹ THE FAUNA OF BRITISH INDIA, INCLUDING CEYLON AND BURMA.—MAMMALIA. By W. T. BLANFORD, LL.D., F.R.S. Part II., 8vo; London, 1891; pp. i-xx, and 251-617; illustrated.

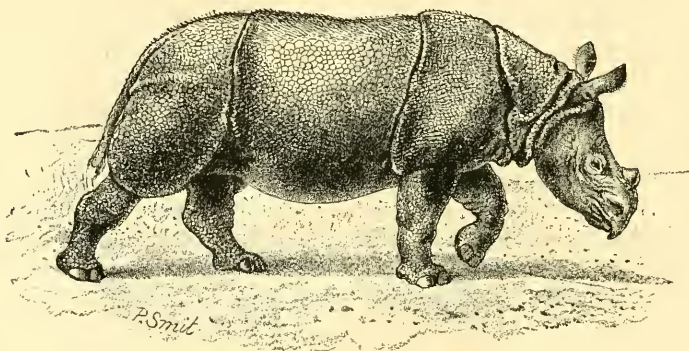
242; but then we must recollect that Jerdon's area was a much more limited one, excluding Ceylon and the regions north of the main axis of the Himalaya, as well as those to the westward of the Indus, and eastward of the Bay of Bengal. In Mr. Sterndale's volume on the same subject, issued in 1884, the number was, indeed, raised to upwards of 482; but some of the species there recorded do not occur within the limits of British India, while fuller observations have shown that others are not entitled to rank as distinct. The greatest additions to the number of valid species living within the strictly British Indian area since Jerdon's time occur, as might have been expected, among the so-called Micro-Mammalia, viz.: Bats, Insectivores, and Rodents; while, as might likewise have been predicated, the group of which our knowledge is least satisfactory is that of the Cetaceans. As regards the main scheme of mammalian classification, Mr. Blanford practically follows the one adopted by Professor Flower in his later works. We shall find, however, as we proceed, that some important changes have been made in the limits of genera upon those which have been adopted by several recent writers; while there are certain not less noteworthy emendations in the specific names applied to some of even the most well-known Indian mammals.

Not the least important feature of Mr. Blanford's work is the happy blending of strict technical description and detail with readable and interesting notices of the habits and mode of life of the various animals described. This ought to make the book as acceptable to the amateur lover of natural history and the sportsman as it must be indispensable to the professed zoologist. Since, moreover, the author has paid great attention to the dimensions and weights of the larger Indian mammals, we trust that, for the future, we shall hear no more of 13 ft. tigers, and other similar monsters, which frequently repel the scientific zoologist from studying sporting works with the attention that, in other respects, they may merit.

Another feature to which we are fain to draw special attention in the work before us is the excellence of the illustrations. With the exception of a certain number reproduced from other works, these have been executed by one of the numerous photographic processes now coming so largely into use; and their fidelity to details proclaims the superiority of this mode of illustration over the ordinary woodcut. Among the figures of the larger mammals which strike us as worthy of special commendation we may refer to those of the two species of Rhinoceros, to that of the Bharal, and to those of the horns and heads of the Markhor. Four of these, by the courtesy of the author, we are enabled to reproduce.

As the larger terrestrial animals are those which are likely to be the most interesting to the majority of our readers, it is to these that we shall mainly confine our remarks. Under the title of *Elephas maximus*, we fear that our old friend *Elephas indicus*—the Indian elephant—will scarcely be recognised; and we cannot help regretting

that the author has felt himself compelled to make this change in nomenclature, seeing that the name *E. indicus* was published by Linnæus in 1754, although in the "Syst. Nat." of 1766 both the Indian and African species were included under the common title of *E. maximus*. Apart, however, from such questions, we may venture to hope that the emphatic statement by Mr. Blanford that elephants are furnished with deciduous milk-tusks, which precede the large permanent tusks, will for the future spare us from sentences like the following, which we extract from Mr. Sanderson's "Thirteen Years among the Wild Beasts of India," where it is stated in reference to the occurrence of these milk-tusks, that "the error—as it undoubtedly is—has arisen through some *savant's* diagnosis of the elephant's dentition, based on analogy, or the confounding the teeth and the tusks, as the same word is used to denote either in several languages." With regard to the question of the height attained by the Indian elephant, Mr. Blanford observes that adult males do not, as a rule, exceed nine feet; he quotes, however, Mr. Sanderson as having measured one



The Javan Rhinoceros (*Rhinoceros sondaicus*).

individual of 10 feet $7\frac{1}{2}$ inches, while the late Sir Victor Brooke is reported to have killed another of upwards of 11 feet in height. A mounted skeleton of an Indian elephant in the museum at Calcutta measures, however, as much as 11 feet 3 inches in height, and if correctly articulated would indicate a height of some 12 feet in the living condition; but Mr. Sanderson states that he found the thigh bone in that skeleton was scarcely longer than that of an elephant of less than 10 feet, so that further investigations are required before these extreme dimensions can be definitely accepted.

Passing on to the Perissodactyle Ungulates, we may note that Mr. Blanford regards all the wild asses of Asia as referable to a single species—*Equus hemionus*. Of the Rhinoceroses, Mr. Blanford figures two out of the three Indian species; and, as we have already mentioned, these figures—of which we reproduce one—may be cited as excellent examples of illustration by "process." Although the author mentions that the lower tusks of the rhinoceros are regarded

by some zoologists as corresponding to the canine teeth of other mammals, we regret to see that this view is not adopted in the text, since it appears to us that the evidence of certain fossil Ungulates renders it indisputably correct. Some interesting observations are given as to the habits and former distribution of the Great Indian Rhinoceros (*R. unicornis*) among which we observe that the time-honoured tradition of its enmity to the elephant is finally disposed of. In accordance with the views of most zoologists, Mr. Blanford regards the small Hairy Rhinoceros of Chittagong merely as a variety of the two-horned Sumatran species (*R. sumatrensis*).

The true Ruminants, or Pecora, from their numerical abundance, necessarily occupy a considerable portion of this part of the



The Bharal, or Blue Sheep (*Ovis nahura*).

volume. Among these, the five Indian species of wild cattle are included in the single genus *Bos*; a peculiar pale-coloured variety of the Buffalo (*Bos bubalus*) receiving a new name. The difficult question as to the real number of species of wild sheep in India and Central Asia receives new light from Mr. Blanford's study of the magnificent series of heads of these and other Ungulates recently presented to the British Museum by Mr. A. O. Hume. In the first place, the specific distinctness of the Tibetan Argali (*Ovis hodgsoni*) from the true Argali (*O. ammon*) of Siberia, is, at least, provisionally admitted. Next comes the mighty *Ovis poli*, in which Severtzoff's *O. karelini* is included, according to observations previously published by the author. The definite identification of the Urial of the Punjab—commonly known as *O. cycloceros*—with the Tibetan Sha (*O. vignei*) now appears, however, for the first time, although it

has already been hinted at by several writers. The Punjab Urial must, accordingly, be regarded merely as a local race of the Sha, modified by the low elevation and the hotter climate of the regions which it inhabits. We reproduce Mr. Blanford's excellent figure of the Bharal, or Blue Sheep of Tibet (*O. nankura*) which forms a connecting link between the more typical sheep and the goats.

In the latter group, Mr. Blanford's observations on the extraordinary range of variation presented by the horns of the different races of the Markhor (*Capra falconeri*) will be read with interest. In spite of the extreme difference in the horns of the two varieties of



Head and Horns of the Kashmir (A) and the Suleman (B) varieties of the Markhor (*Capra falconeri*).

which the figures are reproduced, there appears to be no doubt but that they both belong to one and the same species, as there are intermediate forms, showing a complete transition from the one to the other through a third variety from Cabul. In separating the Himalayan Tahr and the so-called Nilgiri Ibex from *Capra*, as *Hemitragus*, we think Mr. Blanford is fully justified, since the differences between these animals and the true goats are very considerable; but we are not quite so fully assured as to the advisability of regarding the Goral as generically distinct from the Serows (*Nemorhadus*) although there can be no doubt that if that view be adopted the name *Cemas* is the proper title for the former.

The Antelopes and Gazelles calling for no special remark, we pass on to the consideration of the Cervidæ. Here we note that the author includes all the Indian species, with the exception of the

Muntjacs and the Musk-deer in the Linnaean genus *Cervus*. In connection with the Kashmir Stag (*Cervus cashmirianus*) some important observations are recorded on the other elaphine deer of Asia, which do not properly come within the scope of the work. Among these it is very interesting to note that the great Thian Shan deer (*C. eustephanus*) appears to be so closely allied to the American Wapiti that it is even a question whether it should be regarded as anything more than a variety of that species; thus affording another striking instance of the close relationship of the fauna of the northern regions of Europe and Asia to that of North America. For most of the Indian deer Mr. Blanford retains the specific names by which they are generally known, although in case of the Sambar he has felt compelled to substitute the title of *C. unicolor* for *C. aristotelis*. He further considers that the so-called Equine Deer (*C. equinus*) of the Malayan region is really inseparable from this species. Nothing calls for special notice in the pages devoted to the Chevrotains. In the Swine the author regards the Indian Wild Boar (*S. cristatus*) as entitled to be distinguished from its European congener on account of the more distinct mane on the neck, and the larger size of the last grinding tooth, more especially in the lower jaw. It is, however, suggested that the wild swine of Baluchistan will prove to belong to the European species.

In treating of the Cetaceans, the author mainly follows Professor Flower's arrangement, although, as a provisional measure, certain Indian whales are regarded as specifically distinct from the northern forms to which they are severally allied.

We regret that space does not permit of our making extracts from Mr. Blanford's admirably condensed accounts of the habits of some of the animals of which he treats in such a pleasant, but, at the same time, such an exact style. All our readers who are in any way interested in the subject of the volume before us will, however, be well advised if they consult the original. And, in conclusion, we can only say that the entire work is in every respect worthy of the high reputation of its author, both as a technical zoologist and as an observer of the habits of animals in the field.

R. LYDEKKER.

SOME NEW BOOKS.

THOMAS SOPWITH, M.A., F.R.S. With Excerpts from his Diary of Fifty-seven Years. By BENJAMIN WARD RICHARDSON, M.D., F.R.S., &c. 8vo. London Longmans & Co., 1891. 8vo. Pp. 400. Price 6s.

AS a worker in Applied Science, the name of Thomas Sopwith takes a distinguished position. Born in 1803 at Newcastle-upon-Tyne, and brought up as a land surveyor, he was in early life much occupied with surveys of mines and roads, in planning the construction of bridges and other architectural works. Indeed, in 1829 he was successful in competing with McAdam—then in the zenith of his fame—for the construction of a road in the North of England. In course of time he was engaged on many surveys for railways in different parts of the country, and in connection with these labours he was brought into contact with the Stephensons, with William Smith, Telford, and others. He made an important mineral survey of the Forest of Dean, and the large models which he constructed of this and other districts won him, in 1842, the honour of a Telford Medal at the Institute of Civil Engineers. Throughout the greater part of his life, Mr. Sopwith was more or less intimately connected with the mining district of Alston Moor, of which he published plans and geological sections, and in 1833 a small volume, in which the Physical features, Geology, and Antiquities were described, together with a particular account of the lead mines. From 1838-41 he acted as a Commissioner on behalf of the Crown in the Dean Forest, and from 1845 to 1866 he held the chief agency of Mr. Beaumont's lead mines in Northumberland and Durham, residing twelve years at Allenheads.

Throughout his career the careful record of facts was a constant aim with Mr. Sopwith. He advised the publication of accounts of railway sections, and, in conjunction with Dr. Buckland and Sir Charles Lemon, was instrumental in gaining the establishment of the Mining Record Office. He was naturally interested in the formation of the Museum of Economic [now "Practical"] Geology, and published in 1843 the first guide to the Museum. He also published "A Treatise on Isometrical Drawing, as applicable to Geological and Mining Plans," &c., a work which met at the time with marked success, and of which a second edition afterwards appeared.

To geologists, Sopwith's Geological Models—brought before the Geological Society in 1841—are familiar. Constructed of various kinds of wood, they served admirably to represent the nature of stratification, of outcrops, faults, and mineral veins. Figures of them were published by Lyell in his "Elements of Geology."

The character of the man is illustrated by the remarkable diary which he kept for the long period of fifty-seven years. This diary has furnished the chief materials for the biography. It contains records of all the leading events in Mr. Sopwith's life, of individuals he met, of occurrences that came under his observation, together with extracts

from MSS. and rare books, pedigrees, plans, and notes relating to antiquities, &c., and many statistics.

Among the records we find reminiscences of Dr. John Dalton, John Buddle, John Taylor, William and Robert Chambers, Dr. and Mrs. Somerville, Faraday, Babbage, Ruskin, Buckland, Murchison, John Phillips, Lord Armstrong, and others.

Mr. Sopwith visited Dr. Buckland in 1837, and notes that, "Dr. Buckland's house is one of those venerable fabrics which form the principal quadrangle of Christ's College. As soon as the old-fashioned door is opened, abundant evidence is presented that the residence is that of a zealous disciple of geology. A wide and spacious staircase has its floors, and even part of steps, covered with ammonites, fossil trees and bones, and various other geological fragments, and in the several apartments piles upon piles of books and papers are spread upon tables, chairs, sofas, bookstands, and no small portion on the floor itself."

Some account is given of a visit, in 1839, to Mr. Babbage, when Mr. Sopwith inspected the famous calculating machine: "After thirteen or fifteen years' labour, and an expenditure of twenty thousand pounds, the engine was suspended for lack of further funds five years ago, and it is yet uncertain whether it will be completed. I saw a portion of it which was placed in the drawing-room, and performed the operation of cubing eighteen in *thirteen seconds* by merely *grinding*, or rather by moving a handle backwards and forwards twice."

In October, 1841, Mr. Sopwith accompanied Dr. Buckland to North Wales, and in the following year to Northumberland, in search of rounded and furrowed rocks, the work of glaciers. A humorous memento of these explorations is an etching of the Professor—not mentioned in the volume—which was reproduced by Sir A. Geikie in his *Life of Murchison*, vol. i., p. 309. It represents Buckland equipped for an Arctic climate, and with bags and rolls of maps, standing on a surface scored by "prodigious glacial scratches," and alongside are two blocks, one "scratched by a glacier 33,333 years before the Creation," the other "scratched by a cart-wheel on Waterloo bridge the day before yesterday," the whole "scratched by T. Sopwith."

Dr. Richardson tells how he first met Mr. Sopwith, in 1856, at Hartwell House, the residence of Dr. John Lee, where from thirty to forty visitors, including many eminent in different branches of science, were at various intervals entertained. The acquaintance then made, ripened into a life-long friendship, and Dr. Richardson was ultimately asked by members of the family to prepare this biography.

The task of selecting materials from so copious a diary must have been a difficult one; the excerpts given are mostly those which have a popular interest.

Considering that Mr. Sopwith's life-work was connected with engineering, and especially with mining geology, more particulars of his scientific work would have been of value. We read, for instance, on p. 127, that "a very interesting geological survey about Newcastle, carried out by himself and Dr. William Smith, in connection with the new lines of railway then springing up, occupies a good space in the journal, and introduces us to Sir William Jackson Hooker," but no further record is given. Hence, we feel that with the ample material before him, the advice of someone especially interested in Sopwith's work would have been of service to the biographer.

H. B. W.

THE HORSE: A Study in Natural History. By W. H. FLOWER. London: Kegan Paul, Trench, Trübner & Co., 1891. 12mo. Pp. 196. Price 2s. 6d.

A WELCOME may be given to this volume—the second in the “Modern Science Series,” edited by Sir J. Lubbock—as tending to popularise the idea that the animals of the present day can only be properly studied with the aid of the light thrown by their extinct allies; this intimate connection between living and extinct forms being in no case more marked than in that very specialised animal, the modern horse. Professor Flower divides his subject into four chapters; the first treating of the horse’s place in nature, and its ancestors; the second of its existing relations; and the third and fourth of the structure of the horse itself.

The tracing of the ancestry of the horse from the five-toed *Phenacodus* of the lowest Eocene to the one-toed creatures with which we are familiar, is in the main admirable, although we notice some points where it is scarcely up to date. For instance, it is surely hardly fair to refer to a paper by Madame Pavlow published in 1887, and to ignore the work of Scott and Osborn in 1889. Had the latter been referred to, we should not have seen *Hyracotherium* appearing on one page and the identical *Eohippus* on another; neither should we have met with any uncertainty as to the rights of *Pachynolophus* and the identical *Orohippus* to represent a well-marked genus. We should not, moreover, have had matters complicated by any suggestion of the typical *Hyracotherium*, with its three-toed hind foot, being identical with the five-toed *Phenacodus*. Then, again, we miss any reference to the genera *Systemodon* and *Epilhippus*, which should find a place in the series.

In the second chapter we have a good description, and excellent illustrations of the various existing species of Perissodactyle Ungulates; but it seems rather strange to find the extinct *Hipparion* included under the heading of the horse’s existing relations. We might, too, have been surely spared, in a work of this nature, a discussion as to whether or no the name *Hipparion* ought to give place to *Hippotherium*, as this cannot much interest the general reader. Again, when discussing the slight importance of the presence of a lachrymal gland in the *Hipparion*, and its absence in the modern horse, in regard to the descent of the one from the other, it would surely have added force to the argument to mention that such a gland actually existed in an extinct horse from India, and also in another from South America.

The two chapters devoted to the structure of the horse are beyond praise, and especial interest will attach to the author’s description of the so-called “false nostril,” and still more to his discovery that the “ergot” of the horse’s foot represents the foot-pads of less specialised mammals.

Space prevents our calling attention to other points of interest, but we may conclude our notice by saying that if the natural history of every animal were treated as exhaustively as is that of the horse in the work before us, naturalists would have but comparatively little to do in the future.

R. L.

THE Royal Society has issued the first part of its new *Catalogue of Scientific Papers* for the years 1874–1883, inclusive. The volume comprises 1,016 pages, and extends to the name of Gissler. It is not complete, but the Council promises to deal with publications not hitherto catalogued in a supplementary volume.

CATALOGUE OF THE SPECIMENS ILLUSTRATING THE OSTEOLOGY OF VERTEBRATED ANIMALS, RECENT AND EXTINCT, CONTAINED IN THE MUSEUM OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND. Part iii., Class Aves. By R. Bowdler Sharpe, LL.D. Pp. lviii., 468. London: Taylor and Francis, 1891.

THIS new volume of the Osteological Catalogue of the Royal College of Surgeons is arranged upon the same plan as the previous volume by Professor Flower relating to the Osteology of the Mammalia. An important innovation, however, is the addition of a series of good figures of skulls, feet, and other anatomical points of value in the systematic arrangement of the class to which the work refers. With slight modifications, Dr. Sharpe adopts Mr. Henry Seebohm's classification of birds as propounded in 1889, and he acknowledges his indebtedness to Dr. R. W. Shufeldt during the passing of the sheets through the Press. Apart from its value as an index to the collection of which it treats, the volume will form a most useful work of reference for ornithologists, who too frequently ignore the osteological characters of birds in their systematic writings.

GEOLOGIE VON BAYERN. By Dr. K. Wilhelm von Gümbel. Vol. ii., Part i. Pp. 176. Kassel: Theodor Fischer, 1892.

THE second volume of Dr. von Gümbel's Geology of Bavaria is accurately described by its title. The first volume of the work, it will be remembered, forms a general treatise on Physical and Stratigraphical Geology. After a general sketch of the formations represented in the country, the various districts are now to be treated separately in detail, and the text will be illustrated by many good sections and views of scenery. The description of the Bavarian Alps in the first part now before us leads to the discussion of many facts of great interest.

ANNALS OF BRITISH GEOLOGY, 1890. A Critical Digest of the Publications and Account of Papers read during the Year—with Personal Items. By J. F. Blake, M.A., F.G.S. 8vo. Pp. x., 352. London: Dulau & Co., 1891. Price, 5s. net.

THIS most useful work is decidedly an advance in the right direction, and Professor Blake's wide experience in many departments of Geological and Palæontological research makes him specially fitted to inaugurate the new era in "Records" that we hope will dawn with it. As the Professor remarks, the annual summaries of progress in Science would be of much greater value if they could be made readable; and, so far as British Geology is concerned, the present volume amply realises the author's ideal. Each work, or paper, is noticed separately, while the entries are numbered and classified by subjects. Professor Blake's own comments and criticisms are placed in square brackets, to distinguish them from the abstracts they help to enliven. Some of these interpolations are likely to arouse—indeed, have already aroused—the scientific wrath of the authors reviewed; but many are extremely good, and will prove an incentive in some cases to more careful work. Professor Blake's "Annals" ought to find a place in every working geologist's library, and we hope the reception of the volume for 1890 will justify the continuance of the publication.

BRITISH EDIBLE FUNGI: How to Distinguish and how to Cook them. With coloured plates of upwards of forty species. By M. C. Cooke, M.A., LL.D. Pp. 237. London: Kegan Paul, Trench, Trübner & Co., 1891. Price 6s. net.

"FUNGUS-EATING is on the increase, thanks to field clubs and their fungus forays; but the complaint has been heard for many years that no efficient handbook for the guidance of young or inexperienced mycophagists could be found in the English language." With this apology for the present work, Dr. Cooke, as one of the oldest fungus-eaters, yielding at last to the importunities of his fungus-eating friends, proceeds to give the results of his experience. In this he does not confine his remarks to a mere description of the different species, their habitat, and season, but adds copious notes on their preparation for the table.

A preliminary chapter is devoted to proving that fungus-eating is "ancient in its origin, and of wide geographical distribution." Martial says Boleti were so prized by the Romans that it was unsafe to send them by a messenger, though one might trust him with silver or gold; because, explains Dr. Cooke, he would eat them by the way. Dr. Curtis enumerates "130 excellent species" in the United States. In India "natives eat fungi promiscuously, chopping up the different species together, without any ill effects." In the Malay Peninsula, China, and Japan, dried fungi are an article of commerce, and largely used in soups. Lastly, in Tierra del Fuego they form for several months the staple food of the country. Moreover, we must not regard the many edible species as a mere substitute for Mushrooms, but as having an endless variety in flavour.

Chapter II. is "explanatory," containing a few general hints. The author can give us "no rule which shall be of universal application in the discrimination of dangerous fungi. The only safeguard is to become acquainted, by means of well-defined features, with some of the best of the esculent species," and to avoid rash experiments in doubtful cases. "There is no difficulty in recognising all the best kinds by means of ordinary intelligence and care." "Good Fungi," we are told, "have usually a pleasant mushroomy odour, a smell of new meal, a faint scent resembling anise, or no particular odour at all." A fragment of the freshly-gathered fungus should have "an agreeable nutty flavour, with no acidity, sharpness, or tingling upon the tongue." Furthermore, it is suspicious "if a fungus, when broken, cut, or bruised, speedily turns of a deep blue or greenish colour." Avoid, therefore, all fungi with a disagreeable odour, a pungency of flavour, and a tendency to become blue when bruised. A species with salmon-coloured spores is rarely worth eating, and may be poisonous. When we have collected our fungi we must "cook without delay, and remember that there is as much art in the cooking as in the selection."

The next 182 pages are devoted to a description of the various species which Dr. Cooke has either eaten himself, or knows or believes to be eaten "without inconvenience" on the continent or in America. We are told when and where to look for each species, and how best to prepare it for the table. The description is written in language as simple as the circumstances admit, and the characters given are all external, so that with the help of the plates the amateur fungus-hunter should, after a little practice, be able to recognise at any rate the most striking examples. There are twelve plates, including figures of forty-four species, but, unfortunately, they are scattered through the book without any relation to the descriptions,

and no reference is made to them in the text. The figures on each plate are only indicated by numbers, and we must refer to the list at the beginning of the book to find whether a species is figured at all, and then search through the book for the particular plate. No description of the figures is given, and it is not even stated whether they are natural size drawings. In some cases, sections, or parts of sections, through the cap are included without any explanation, and these are not in every case all that might be desired, as, for instance, that of the Common Mushroom on Plate 6, Fig. 19. The work is evidently meant to be a popular handbook, and as plates appeal most to the popular mind as a means of identification, we cannot but regret these defects in their arrangement and execution.

At the end of the book there is a list of nearly two hundred edible fungi. About seventy are marked with an asterisk, indicating that Dr. Cooke has himself eaten them. One cannot help thinking that the list is too long, for there must surely be a wide difference between edible fungi which may be eaten "without inconvenience," and those which would form a welcome addition to a meal. Thus, *Lentinus tigrinus* and two species of *Panus* are characterised as "tough when old, and never very delicate or digestible," and we might cite similar or even more doubtful cases. Dr. Cooke's object is evidently to make converts, and we venture to think he would do this more effectually by merely indicating those species which may not only be eaten "without inconvenience," but also whet the appetite, and induce those partaking to go further and try others.

The Tenth Annual Report of the United States Geological Survey for 1888-9, in two parts, dated 1890, has just been received in England. It contains the Report of the Director, Major J. W. Powell, with plates illustrating Standards of Colours for Geological Cartography. The accompanying papers include:—(1) A General Account of the Freshwater Morasses of the United States, with a Description of the Dismal Swamp District of Virginia and North Carolina, by N. S. Shaler; (2) The Penokee Iron-bearing Series of Michigan and Wisconsin, by R. D. Irving and C. R. Van Hise; (3) The Fauna of the Lower Cambrian or Olenellus Zone, by C. D. Walcott; and (4) The First Annual Report of the Irrigation Survey, by the Director. The *Bulletins* of the same Survey issued during 1891 comprise:—(1) The Texan Permian and its Mesozoic Types of Fossils, by C. A. White; (2) Correlation Papers—Devonian and Carboniferous, by H. S. Williams; (3) Correlation Papers—Cambrian, by C. D. Walcott; (4) A late Volcanic Eruption in Northern California and its peculiar Lava, by J. S. Diller; (5) The Minerals of North Carolina, by F. A. Genth; and some good Bibliographies.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE University College of Wales, Aberystwyth, is soliciting subscriptions to provide a suitable and permanent Hall of Residence for the women students of the College. There are at present 40 women in residence, temporarily provided for in lodging-houses superintended by the Lady Principal.

The second Semester of the new Leland Stanford Junior University, Palo Alto, California, began on February 2. During the first Semester there were 490 students, 110 being women, and no less than 329 being residents in the State of California. The Engineering classes seem to have been most successful, while the classes for Natural Science were very small, except in Physiology. The President of the University is the well-known zoologist, Prof. David S. Jordan.

Mr. J. J. Lister, M.A., has been appointed Demonstrator in Animal Morphology in the University of Cambridge, in succession to Mr. S. F. Harmer, M.A., who is now Superintendent of the Museum of Zoology.

The official opening of the "Laboratory for Lacustrine Biology," founded by Dr. Otto Zacharias at Plön, between Kiel and Lubeck, is announced for April 1st. We hope next month to give some account of the Institution.

Subscriptions towards several memorials are being solicited. At Cambridge, a portrait of the Professor of Physiology, Dr. Michael Foster, Sec. R.S., is to be presented either to Trinity College, or to the University, by a committee of which Dr. Lea (Gonville and Caius College) is Secretary. At Cambridge, also, the Professor of Geology, Mr. McKenny Hughes, F.R.S., is collecting a fund for the benefit of the widow of his late assistant, Mr. Thomas Roberts, F.G.S. The Royal College of Science, London, will shortly decide upon the form of a memorial to the late Sir Warington W. Smyth, F.R.S., for which nearly £300 has already been subscribed. At Breslau, geologists will honour the memory of the late Professor Ferdinand von Roemer by placing a marble bust in the Geological Institute of the University.

According to the *Geological Magazine*, the Earl of Ducie has just erected at Churchill, Oxfordshire, an appropriate roughly-hewn monument of Oolitic ragstone to the memory of William Smith, the "Father of English Geology," who was born at that village in 1769.

We have often heard from specialists expressions of disapproval of the meagre facilities afforded them for the use of the great collections in the Museum of Comparative Zoology at Harvard College, Cambridge, Mass. Both on personal visits and in correspondence we, too, have met with some disappointment. We cannot, therefore, do better than quote from Dr. Alexander Agassiz's latest Annual Report (1890-91), which shows how the Curator himself appreciates these difficulties,

and is desirous of effecting a change that shall be beneficial both to the course of University teaching and to the progress of Natural Science :

" We are unfortunately compelled for want of funds gradually to restrict the work of the assistants of the Museum to the mere care and maintenance of the collections, and to limit their use by specialists. Our inability to engage a sufficient number of assistants compels us to refuse many of the constant demands made upon the administration of the Museum for an opportunity of working up or of examining parts of our collections, the value of which to science is thus greatly diminished. It is true we have a number of volunteer assistants, but we cannot expect these gentlemen, who have kindly undertaken the general supervision of special departments, to spend their time in the drudgery necessary to meet the legitimate demands which every fairly organised Museum ought to be able to meet, and which are naturally made upon our collections and assistants. With the exception of Dr. Hagen and Mr. Garman, there is no assistant upon whom I feel at liberty to call for work of that kind. The annual expenditure of a comparatively moderate sum would go far to remedy the unfortunate attitude we are compelled to assume towards specialists. But I need not dwell upon the unsatisfactory condition of the Museum finances. As I have stated in former Reports, it is no longer practical for me, in connection with other plans I have in view, to continue to give to the Museum the support, or devote to its interests the time it has hitherto received from me. It is becoming self-evident that an attempt to establish at Cambridge a Museum devoted to original investigation, in addition to its other functions of providing a University Museum and Laboratories, is not destined to be carried out. We cannot compete with the general government or municipal institutions without an endowment or resources far greater than any University can hope to obtain, and the sooner the future plans of the Museum are modified to meet the existing state of things, the less will be the waste, and the sooner shall we adapt our organisation to the comparatively limited field of a University establishment."

Notwithstanding all difficulties, the Cambridge Museum Bulletin still continues to hold its important position among American scientific journals; and the exhibition rooms are being enriched with many valuable additions. A magnificent series of skeletons of Edentata from the South American Pampas, collected and mounted by Professor H. A. Ward, was added last year.

It is satisfactory to learn that negotiations are in progress for the acquirement of the Bristol Museum by the city. Subscriptions to the Museum and Library have of recent years decreased so much as to prevent the committee from making adequate provision for the custody of the Natural History Collection. Some departments of the Museum—notably those of Geology and Palæontology—are so rich in unique specimens that all interested in scientific work will unite in good wishes for the success of the new scheme. That the efforts of the Curator, Mr. Edward Wilson, are appreciated by ordinary visitors, is indicated by the fact that no less than 3,000 copies of his "Guide to the Bristol Museum," issued in September, 1890, were sold within fourteen months. A second edition of this admirable little handbook has just reached us.

We are glad to state that during the political strife of the past year in Chili, the French residents in that country have succeeded in founding a Scientific Society which promises to contribute largely to our knowledge of the Natural History of South America. The new organisation is entitled the *Société Scientifique du Chili*, and its General Secretary is Professor Fernand Lataste, the well-known French zoologist, who has resided in Chili for the last three years. The membership of the Society is composed of persons of every nationality residing in the Republic, and the contributions are presented either in French or Spanish, at the discretion of the respective authors. The Society will shortly issue the first part of its *Actes*, with an appeal for support to the principal Scientific Societies of Europe and North America. We have been favoured with an advance copy of the *Procès-Verbaux* of November 16th, 1891, in which M. Lataste refers to his work on the dentition of the Mammalia, and to a novel method of capturing Petrels. M. P. Germain communicated to the same meeting some observations on the habits of monkeys, and the President, M. A. Obrecht, referred to the lunar eclipse of November 15, as also

to an earthquake of the following day. The address of the new Society is at Santiago, Chili, and our fellow-naturalists in the Republic have our best wishes for success.

We understand that a Committee, with Dr. Josua Lindahl as chairman, is organising another International Geological Congress to meet in Chicago during the Columbian Exhibition in 1893.

The Proceedings of the Dorset Natural History and Antiquarian Field Club for the session 1890-91 were published in January, forming vol. xii. of the series. In addition to Mr. Mansel-Pleydell's presidential address, there are illustrated papers on the stone implements, &c., in the Dorset County Museum, by H. J. Moule, M.A.; on new and rare spiders found in 1889-90, by Rev. O. Pickard-Cambridge, F.R.S.; on the occurrence of *Tinea subtilella* at Portland, by Nelson M. Richardson, B.A.; and on ancient British urns, by Dr. Wake Smart. Notes on some of the rarer forms of *Rubus* lately found in Dorset, are contributed by Rev. R. P. Murray, M.A.; and there is a new list of the land and freshwater mollusca, by C. O. P. Cambridge. A short paper on the Portland Stone Quarries, by A. M. Wallis, gives much detailed information. The volume concludes with a tabulated statement of meteorological and phenological observations, by the hon. secretary, Morton G. Stuart, M.A.

The members of the Dorset Field Club are regretting the retirement of their president, Mr. J. C. Mansel-Pleydell, F.L.S., who is, unfortunately, prevented by ill-health and advancing years from taking so active a part in scientific work as formerly. Mr. Mansel-Pleydell has been a central figure among the naturalists of Dorsetshire for the last 25 years, and has presided over the Field Club since its foundation in 1873.

In his Presidential Address to the Entomological Society of London on January 27, Mr. F. Du Cane Godman, F.R.S., referred to the difficulty in obtaining a sufficient number of specialists to deal with the enormously increasing lists of genera and species of insects. The number of forms recognised by entomologists is already appalling, and if satisfactory progress is to be made in the future, there must be a further division of labour among the systematists.

At its annual meeting on February 5, the Geologists' Association of London adopted a new procedure in electing a lady, Miss C. A. Raisin, B.Sc., to the office of vice-president. Miss Raisin, a well-known petrologist, had already been a member of Council for three years. Professor J. F. Blake was re-elected president, and delivered his first annual address. Choosing for his subject "The Evolution and Classification of the Cephalopoda," Professor Blake discussed the changes that had taken place in the study of this group of fossils during the last twenty-five years, and pointed out the wide-reaching significance of these changes. The legitimate outcome of the progress would be, the abolition of Linnean nomenclature in the study of successive races of extinct organisms: they would be arranged, instead, in "mutations" and "lineages."

At the annual meeting of the Geological Society of London on February 19, Mr. W. H. Hudleston, M.A., F.R.S., was elected president for the ensuing year.

To all who are interested in the progress of Technical Education, we heartily commend Professor Ayrton's Presidential Address to the Institute of Electrical Engineers, reported in *Nature* for February 4. Professor Ayrton gave an interesting sketch of the growth of technical education in this country, showing how much has been done, but how far we still are behind Germany and the United States. His address contained, moreover, many valuable warnings as to the dangers ahead. We wish that all those who are responsible for the future development and working of the new institutes would take them to heart, as well as gain fresh stimulus from the enthusiasm that animated the whole address.

At a meeting of the Royal Irish Academy on February 8, Dr. J. K. Ingram was elected to the Presidency, vacant by the death of the late Bishop of Down.

OBITUARY.

JEAN LOUIS ARMAND DE QUATREFAGES.

BORN FEBRUARY 10, 1810—DIED JANUARY 12, 1892.

BY the recent death of Professor De Quatrefages, the scientific literature of France has lost a contributor whose graceful pen had been active for more than half a century. Jean Louis Armand de Quatrefages de Bréau, of Protestant descent, was born on February 10, 1810, at Berthezème, near Vallerangue, in the Dep. of the Gard. At the University of Strasbourg he took a double degree, graduating as a doctor both of science and of medicine. Physical science seems to have attracted his early attention, as one of his theses, written when only nineteen, was entitled "Théorie d'un Coup de Canon," and the following year he published an essay, "Sur les aérolithes." Among his early writings on natural history was one on the Anodonts, which attracted attention, and probably led to his appointment, shortly after its publication, as professor of Zoology at Toulouse. Dissatisfied, however, with provincial life, he resigned this appointment, after a tenure of only two years, and migrated to the capital, where he was befriended by Milne-Edwards.

In 1842, De Quatrefages commenced a series of scientific expeditions to the Mediterranean and the Adriatic, which he described in a number of articles contributed to the *Revue des Deux Mondes*. These essays were afterwards collected in two volumes, which were published in 1851 under the title of "Souvenirs d'un Naturaliste." An English translation, by E. C. Otté, appeared in 1857, as "The Rambles of a Naturalist on the Coasts of France, Spain, and Sicily."

At length a professorship in the metropolis rewarded the active naturalist. In 1850, he was appointed to the chair of Natural History at the Lycée Napoléon, and five years later he succeeded Serres as professor of Anthropology and Ethnology, at the Musée d'Histoire Naturelle. Although the Science of Man henceforth became his favourite study, he continued for some years to carry on his work on the invertebrata: witness his "Histoire naturelle des Annelés marins et d'eau douce," which appeared in 1865. The diseases of the silkworm also engaged his attention, and as early as 1859 he gave to the world his "Etudes sur les maladies actuelles du Ver à soie," followed the next year by his "Nouvelles Recherches" on the same subject. He was likewise the author of an "Essai sur l'histoire de Sericulture."

Of his purely anthropological works, special mention should be made of the *Crania Ethnica*, in the preparation of which he secured the co-operation of Dr. E. T. Hamy, the keeper of the ethnographical collections in the Trocadéro. It was also in conjunction with Hamy that he projected a great series of works, *Les Races Humaines*, to which he contributed the introductory volume in 1887, when he was 77 years of age. Ten years earlier he had written a popular work, *L'Espèce Humaine*, of which an English translation appeared in 1879, as a volume of the "International Scientific Series."

As an anthropologist he conceded a very high antiquity to the human species, and, like so many other Frenchmen, accepted with little hesitation the evidence on which it has been sought to establish the existence of "Miocene Man." On the other hand, he adhered to a rigid monogenism, after the old controversy had lost to many naturalists its former interest. It was a prominent feature in his teaching that the differentiation of the several races of mankind from a single species had been brought about by the varying influences of the environment. In assigning to Man his systematic zoological position, he held that too much weight had been given to his structural resemblances to the lower animals, and too little to his psychological differences; hence, he held to the last that Man must constitute by himself a distinct kingdom—the *Règne Humain*.

In 1852, Professor De Quatrefages was elected a member of the French Academy of Sciences, replacing Savigny in the section of zoology. In 1863 he was made an officer of the Legion of Honour. But the highest recognition of his merit was reserved until 1879, when he was elected a Foreign Member of the Royal Society. At the second meeting of the *Association Française pour l'Avancement des Sciences*, held at Lyon in 1873, De Quatrefages presided, and delivered an introductory discourse admirably suited to a time when his country was emerging from the shadow of its great misfortune. "Dans ce Siècle de la Science," said the President, "une nation ne saurait être grande et forte qu'en s'inspirant du génie du temps, en s'imprégnant de l'esprit scientifique." F. W. R.

THOMAS ROBERTS.

BORN 1856—DIED JANUARY 24, 1892.

GEOLOGICAL science has suffered a severe loss by the death, at the early age of 35, of Mr. Thomas Roberts, M.A., F.G.S. He was educated at the University College, Aberystwyth, and there his attention was attracted to Geology by Mr. F. W. Rudler, who, at the time, occupied one of the professorial chairs. After a successful career at this Welsh college, Mr. Roberts proceeded, in 1879, to Cambridge, where he entered St. John's College. He took his B.A. degree in 1882, being placed in the first class in the Natural Science

Tripes. In 1883, he succeeded the late E. B. Tawney as assistant to Professor Hughes, the Woodwardian Professor, and gave many lectures and demonstrations in Palæontology. In 1886, he gained the Sedgwick Prize for an essay on "The Jurassic Rocks of the Neighbourhood of Cambridge"—a work which, unfortunately, has not been published. To the Jurassic rocks he had devoted especial attention, having, in the summer of 1884, been sent out by the University of Cambridge, with a grant from the Worts Fund, to study the Jurassic rocks of the Jura. The results of this journey, so far as regards the correlation of the Upper Jurassic Rocks of the Swiss Jura with those of England, were communicated to the Geological Society of London, and published in 1887. Another important paper by Mr. Roberts, on the equivalents of the Corallian beds in Lincolnshire, was published by the same society in 1889.

In conjunction with Mr. J. E. Marr, in 1885, Mr. Roberts had described the Lower Palæozoic rocks of the neighbourhood of Haverfordwest, and he had also written some papers on special Palæontological subjects, describing a species of *Conoceras*, and some abnormal Cretaceous Echinoids. He died on January 24, after an attack of influenza, and in consequence of failure of the heart. He was buried at Tenby, his old home.

JAMES AUGUSTUS GRANT.

BORN APRIL 11, 1827—DIED FEBRUARY 11, 1892.

BY the death, on February 11th, of Col. J. A. Grant, the well-known East African explorer, we seem almost entirely severed from what may be called the Livingstone epoch in the opening out of the Dark Continent. Col. Grant was born at Nairn in 1827, and, after serving with distinction in India, both at the sieges of Multan and during the Mutiny, entered, in 1860, that field of African exploration with which his name will ever be associated. In that year he joined the expedition led by Speke to explore the Victoria Nyanza, which had then been but recently discovered by the latter in his previous expedition with Burton. The two travellers, starting from Zanzibar, journeyed to the north-west side of the lake, and after sojourning in Uganda with the now celebrated late King Mtesa, had the satisfaction of verifying the prediction of the older explorer that the main source of the Nile would prove to be the northern side of the Victoria Nyanza. It was not, however, to be supposed that a mere preliminary reconnaissance, like that which Speke and Grant were enabled to make, could give us an accurate map of the lake, and it is, therefore, no discredit to them that this task ultimately fell to the lot of Stanley. The prolonged absence of the two explorers led to the dispatch of a relief expedition, under Sir Samuel Baker, who met them, in February, 1863, at Gondoroko, on the upper waters

of the Bahr-el-Jebel, the main affluent of the White Nile. For these services to geographical science Col. Grant received the gold medal of the Royal Geographical Society and a C.B.-ship, his C.S.I. being subsequently earned in the Abyssinian expedition of 1868. In biological science Col. Grant will be long remembered by his important memoir on the botany of his African expedition, published in the *Transactions of the Linnean Society*, while his memory will also be kept green in men's minds by that most beautiful of all African gazelles, which the late Sir Victor Brooke so appropriately named *Gazella granti*.

WILHELM JUNKER.

BORN APRIL 14, 1840—DIED FEBRUARY 14, 1892.

ALMOST immediately after that of Col. Grant, the death of another eminent African explorer is announced. At the comparatively early age of 52, Dr. Wilhelm Junker died on the 14th ult. at St. Petersburg. Born at Moscow in 1840, Dr. Junker left his native country at an early age to study in the Universities of Göttingen, Berlin, and Prague, and his first African journeys were in Tunis and Lower Egypt. In 1876 he visited the Soudan, and in 1879 advanced further into the interior of Africa, where he was hindered by the insurrection of the Mahdi, and prevented from returning until 1886. Vols. II. and III. of Dr. Junker's work descriptive of these later travels have already been published in Vienna.

HENRY WALTER BATES.

BORN FEBRUARY 8, 1825—DIED FEBRUARY 16, 1892.

ANOTHER pioneer in the investigation of the Natural History of the Tropics has just passed away in the person of Mr. H. W. Bates, F.R.S., the esteemed Assistant Secretary of the Royal Geographical Society. Born at Leicester in 1825, Mr. Bates was educated for a mercantile career; but his mind was from the first imbued with a love of science that led him to devote all his leisure to the practical study of the Natural History of the country round his native town. Eventually, at the age of 23, he decided to relinquish business for purely scientific pursuits; and in 1848 he left England with Mr. Alfred Russel Wallace, for the exploration of the Amazons. For four years in the company of Mr. Wallace, and for seven years subsequently alone, Mr. Bates was occupied in studying the people, geography, and natural history of that region of South America. He not only made large collections, which were forwarded to the British Museum, and other European museums, but also studied Tropical Nature with the closest attention, and obtained results of the highest philosophical importance. To Entomology, especially, Mr. Bates

devoted his energies, and it was he who first recognised the principle of mimicry in the animal world. On the first publication of Darwin's Theory of Natural Selection, Mr. Bates became a firm adherent of the new school of Biology, and he regarded the doctrine as the only satisfactory explanation of the phenomena of the world of life. Though he returned to England in 1859, Mr. Bates did not complete his classic work, "The Naturalist on the Amazons," until nearly four years later; and his only book of later years was his "Central America, the West Indies, and South America," contributed to Stanford's Compendium of Geography, in 1878. He wrote part of the section on Coleoptera in the "Biologia Centrali-Americana," and in the Royal Society's List of Scientific Papers he is credited with nearly 80 contributions on entomological subjects to various serials and publications of societies. In proportion, however, to his wide knowledge, Mr. Bates wrote little; and in matters relating to the broad questions of Natural History, he was ever ready with brilliant suggestions for anyone who might consult him. As Assistant Secretary of the Royal Geographical Society for a period of 27 years, Mr. Bates was placed in a congenial sphere of influence, that enabled him to make the best use of his philosophic learning and long experience; and British travellers of the present generation will feel that in him they have lost one of their best friends and most valued counsellors.

THOMAS STERRY HUNT.

BORN SEPTEMBER 5, 1825—DIED FEBRUARY 12, 1892.

AFTER a painful illness, which had long incapacitated him from active work, Dr. T. Sterry Hunt, F.R.S., passed away, at New York, on the 12th of February, in his 67th year. Though most of his scientific work was done in Canada, he was a citizen of the United States by birth, having been born in the picturesque little town of Norwich, in Connecticut. He received most of his early education at Hartford in the same State, but obtained his first scientific appointment in New Haven, where, at the age of 20, he became the assistant to Professor Silliman, in the Chemical Laboratory of Yale College. He, however, only remained here two years, being appointed in 1847 Chemist and Mineralogist to the Canadian Geological Survey. In this country he spent nearly the whole of the remainder of his life, for though he resigned his Survey office in 1872 in favour of the Chair of Geology in the Technological Institute of Massachusetts, he soon returned to Montreal. His first scientific publication, containing a notice of the titaniferous minerals, was issued in 1846, and for many years afterwards he poured forth short papers upon various branches of Mineralogy and Chemistry. His work was noted rather for daring originality than for accuracy of thought or observation. He belonged

to the early school of Canadian geologists, whose theories upon rock metamorphism, the deposition of the Laurentian rocks, and the nature of crystalline schists once exercised a wide-spread influence both in Europe and America. He was one of the first describers of Eozoon, and wrote many papers to explain away the chemical anomalies which the acceptance of its organic origin involved. His best known works were his *Chemical and Geological Essays* (1875 and 1879), of which a second series was issued in 1886, under the title "Mineral Physiology and Physiography." These give a good summary of his speculations upon the primæval chemistry of the earth, the cause of volcanic action, the origin of the crystalline schists, and others of the most vexed questions of geology.

On the 15th of December last died, at Amboise, LOUIS FRANÇOIS HÉRON-ROYER at the age of 56. Devoid of education, and earning his living as a mere artisan, Héron-Royer nevertheless succeeded in making himself a name by his investigations on the habits and development of the European tailless Batrachians, a subject at which he worked with great enthusiasm from 1877 to the time of his death. His numerous papers were mostly published by the Société Zoologique de France (of which he acted as treasurer for several years) and the Société d'Etudes scientifiques d'Angers.

Almost at the same time, another Zoologist who has done good work in the study of European herpetology was carried away: Count ALEXANDER P. NINNI, director of the Civic Museum of Venice, who died on January 7th, at the age of 55. Ninni's papers, dealing principally with the Vertebrates of Italy, appeared mostly in the *Atti del R. Istituto Veneto*, and as separate pamphlets published at Venice. A complete list of his works has just been issued by Professor Camerano in the *Bolletino* of the Turin Museum.

We also regret to record the death of the veteran Geologist and Palæontologist, Baron ACHILLE DE ZIGNO, of Padua, who passed away on January 15, at the age of 79.

Observations and Correspondence.

Under this heading we shall be glad to receive short comments on the broader questions of Natural Science, and on new facts of wide significance. Numerous notes of news with which we have been favoured are unavoidably held over, and Mr. Rendle's botanical contribution, announced for this number, is deferred to No. 2.

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